LLNL-PRES-484817

Lawrence Livermore National Laboratory

# Visualization with VisIt

3rd edition

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# Organization and Schedule

- Introduction
- Accessing data and managing files
- Client/Server Visualization
- Working with plots
- <10 minute break>
- Using the visualization window
- Working with operators
- <1 hour lunch break >
- Interactive tools
- Subsets
- Quantitative analysis
- <10 minute break>
- Making it pretty
- Animation and Keyframing

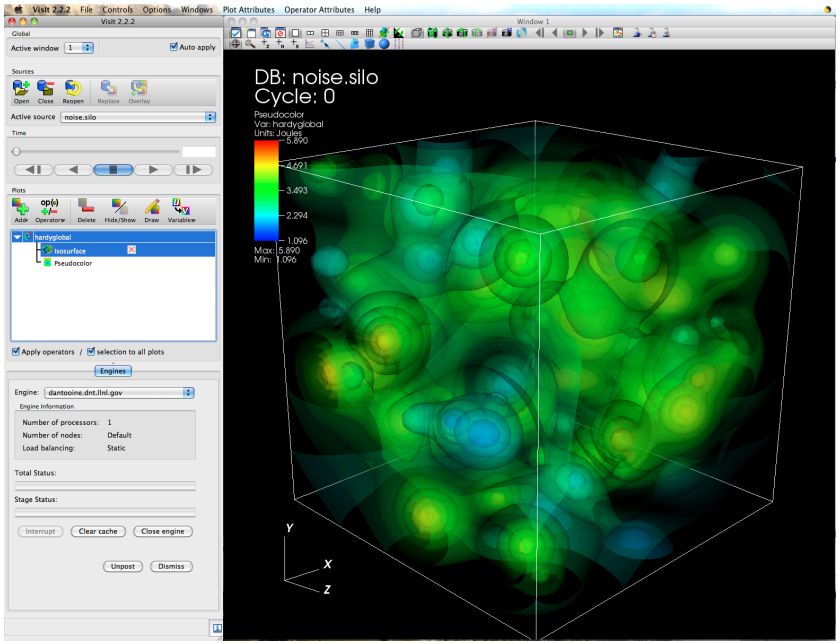
# Goals

By the end of this class you will be able to:

- Access data files on local or remote computers
- Create plots and use operators
- Examine simulation data values
- Create presentation quality slides and movies of simulation data

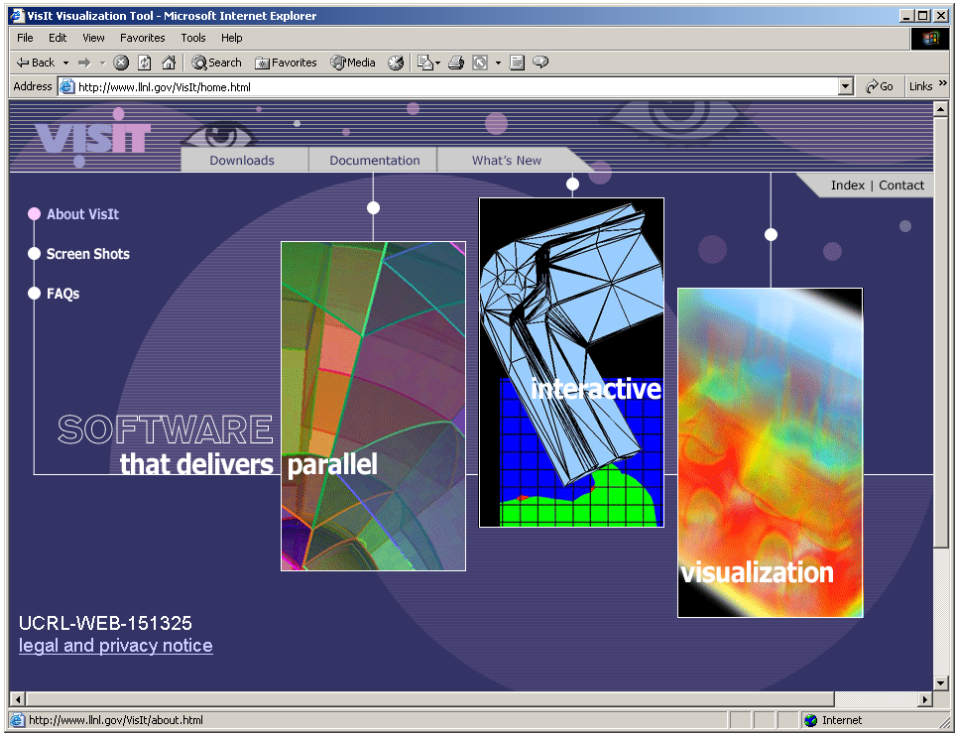
# What is VisIt?

- VisIt is a free software application for visualizing and analyzing terascale and petascale simulation datasets
- Begun Summer 2000
- R&D 100 award winner in 2005
- Used in many research institutions



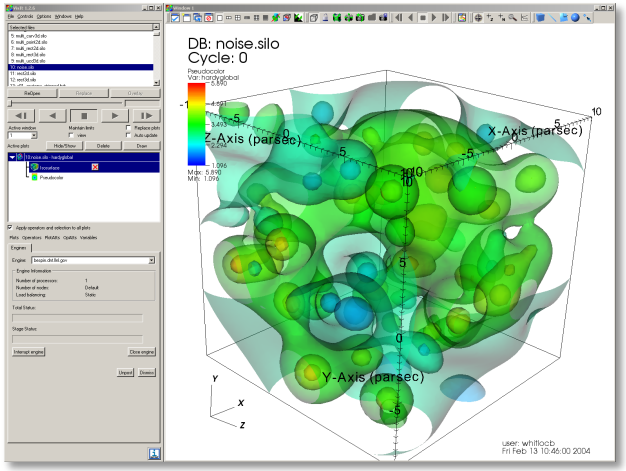
# VisIt is FREELY AVAILABLE

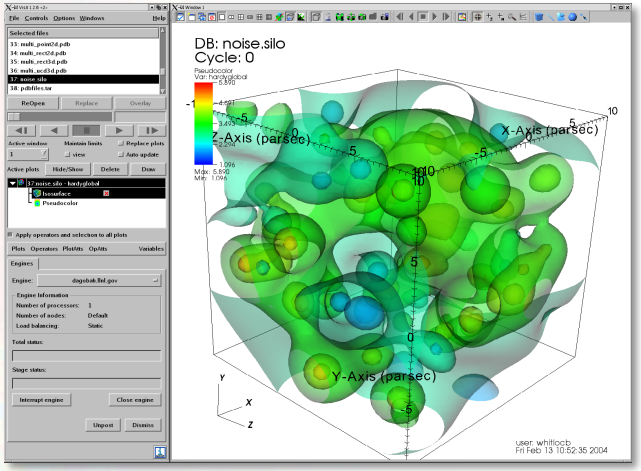
- Download VisIt for free at http://www.llnl.gov/visit
  - Binary distributions
    - Windows XP / Windows 7
    - Linux
    - MacOS X 10.5 / 10.6
  - Source code
  - Documentation
  - Frequently asked questions
  - Gallery of images
- Share VisIt with colleagues

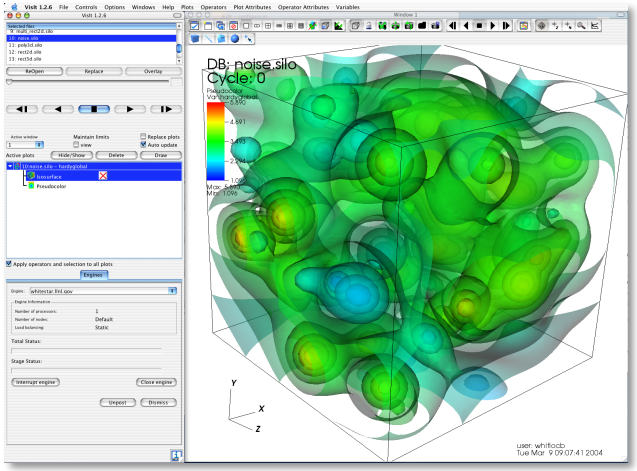


# VisIt runs where you want to work

- Run locally
- Run remotely
- Run client/server
- The interface looks the same on each platform



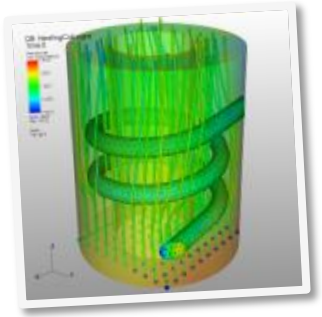



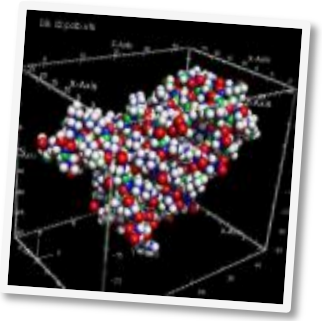



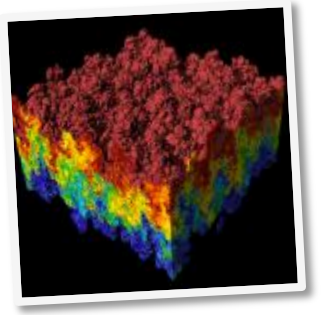
# VisIt Can Access Your Data

- Reads over *100* different data formats
- Database reader plug-ins can be developed for new formats

- Silo
- XDMF
- TecPlot
- EnSight
- VTK
- NETCDF
- Exodus
- PDB
- Mili
- SAMRAI
- BoxLib
- CGNS
- NASTRAN
- Protein Databank
- Plot3D
- GIS formats
- Image formats
- FLUENT

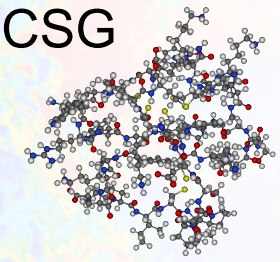




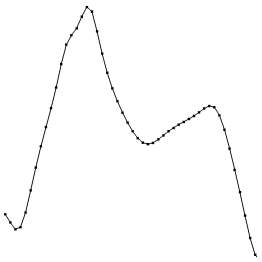


# Supported Mesh Types

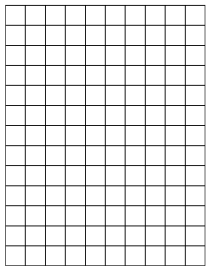
- 1D Curves
- 2D/3D meshes
  - Rectilinear
  - Curvilinear
  - Unstructured
  - Points
  - AMR
  - Molecular
  - CSG



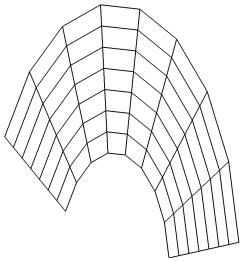
Molecular



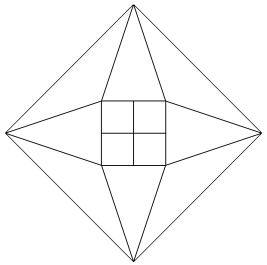
Curve



Rectilinear

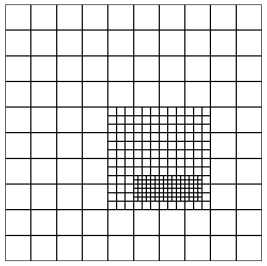


Curvilinear



Unstructured

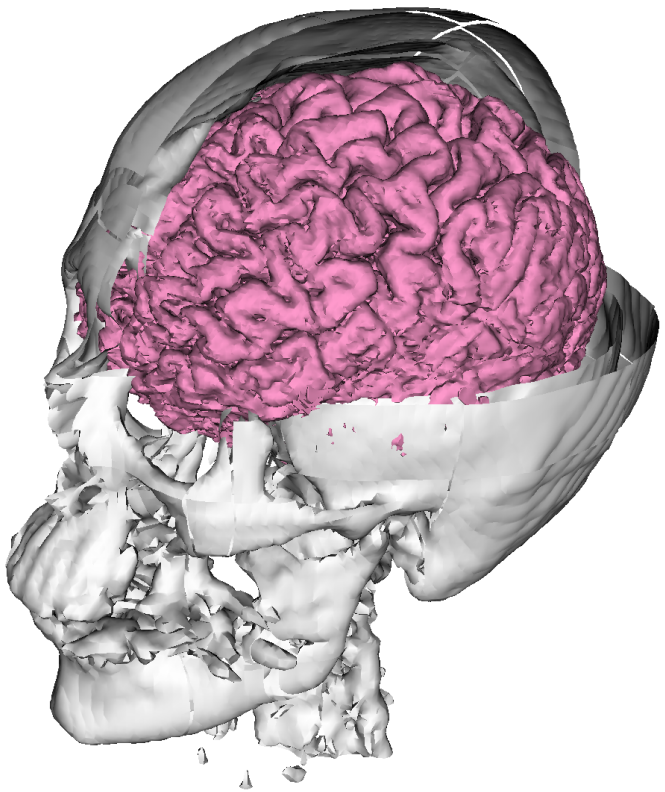
Points



AMR

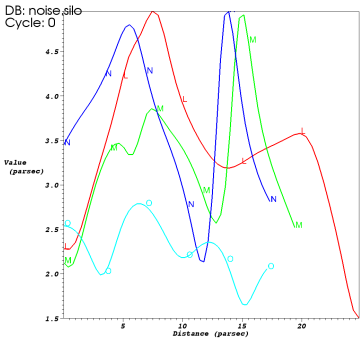
# VisIt Lets You See Your Data

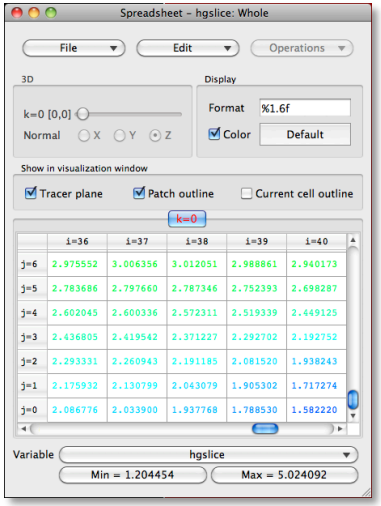
- Plots
- Manipulate data or create new data using operators and expressions
- Develop new plots and operators as plug-ins
- VisIt supports stereo rendering

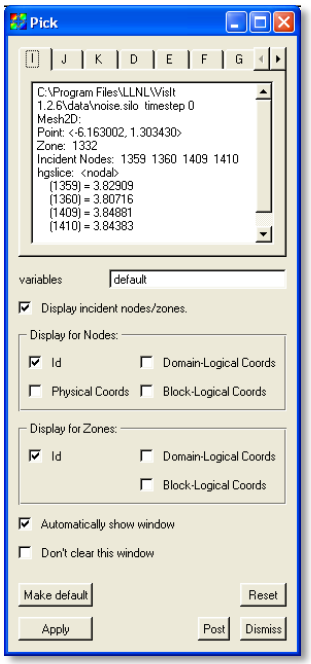


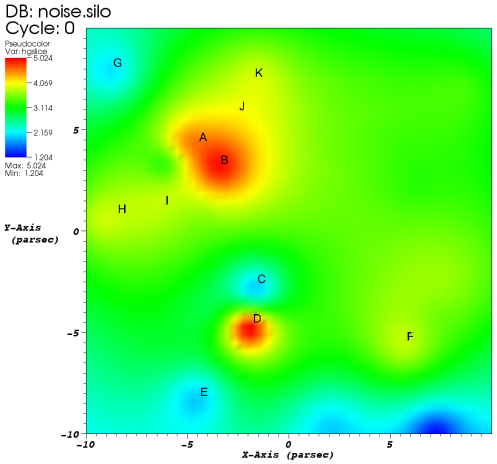
# VisIt Lets You Examine Your Data

- Create derived variables using data from your database
- Pick
- Lineout
- Query
- Spreadsheet



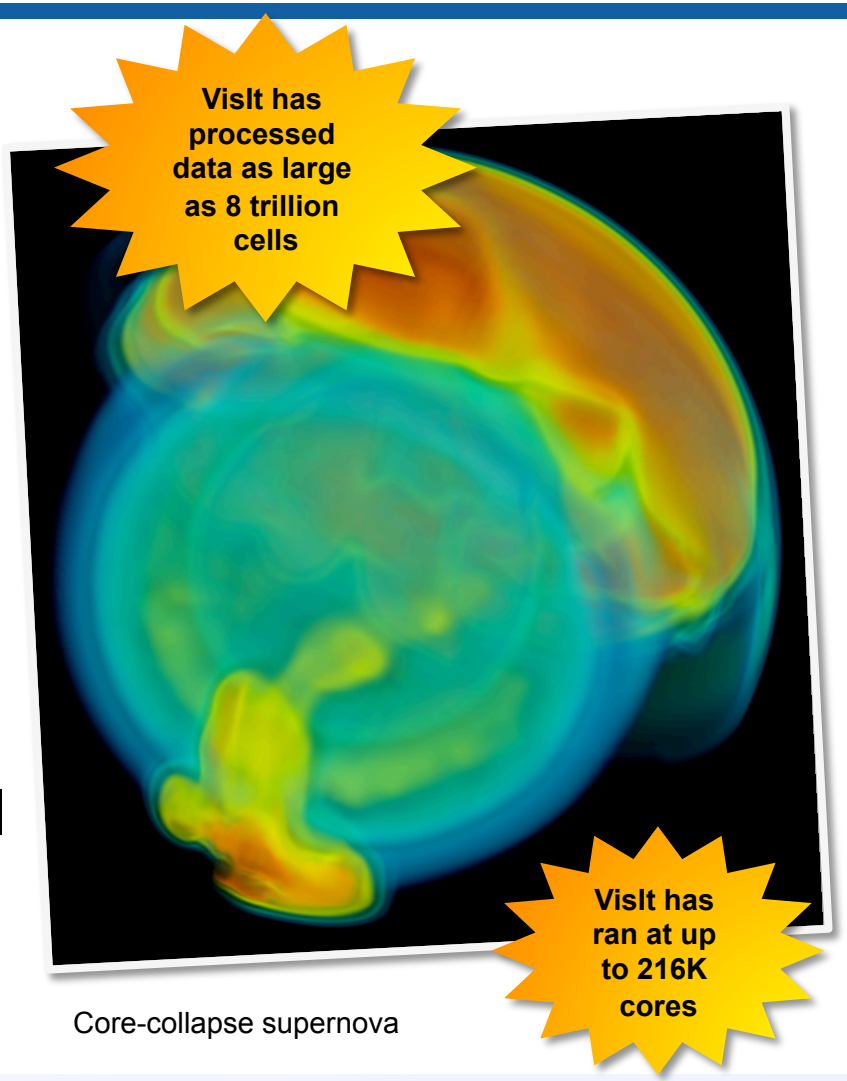



# VisIt Can Handle Large Datasets

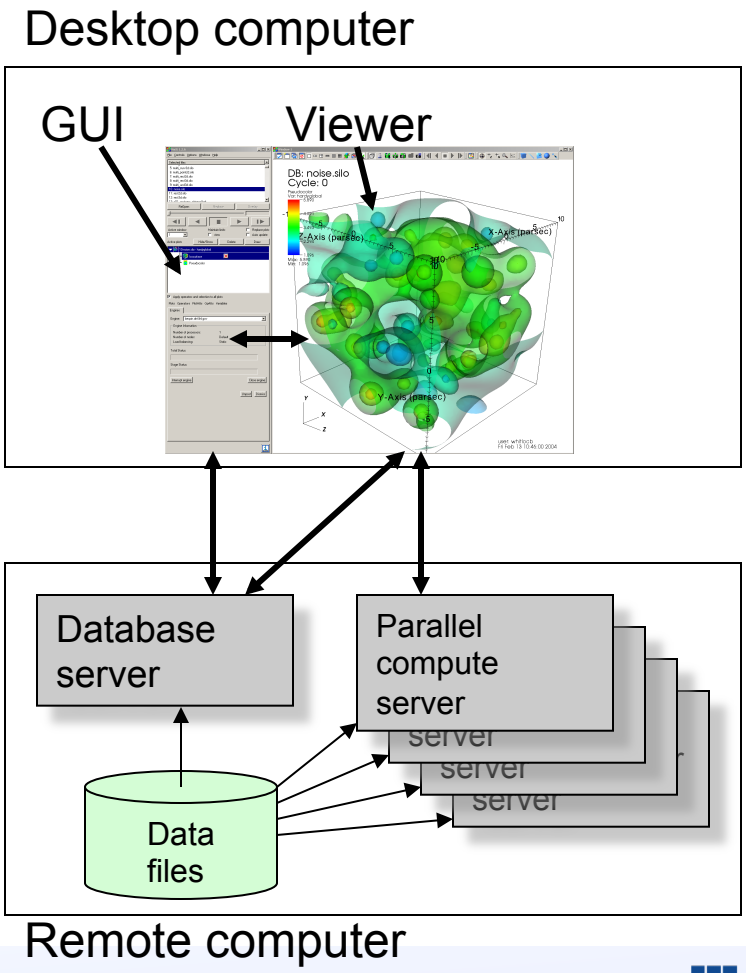
- Client/Server architecture
- You can run VisIt on your desktop computer and have VisIt process large data in parallel on a remote supercomputer
- Uses fast local graphics hardware
- MPI parallel compute engine
- Scalable rendering in parallel for largest datasets




Core-collapse supernova

# VisIt Architecture

- 4 main components
  - Graphical User Interface (GUI)
  - Viewer
  - Database server
  - Compute engine
- GUI and Viewer usually meant to run locally on your desktop computer
- Database server and parallel compute server can run on remote computers where the data files are located

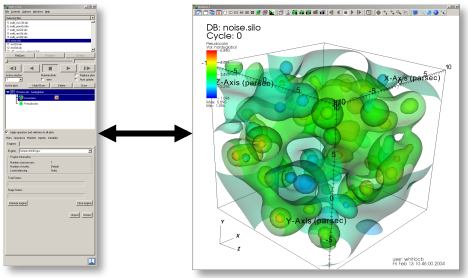


# VisIt Has Multiple Interfaces

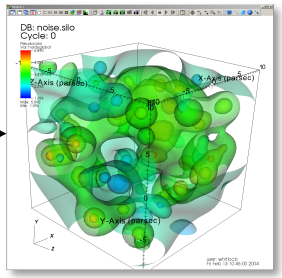
- Interfaces
  - Graphical user interface
  - Python programming interface
  - Java programming interface
  - C++ programming interface
- Use multiple interfaces simultaneously!

- Use VisIt as an application or a library
- C++, Python, Java interfaces allow other applications to control VisIt

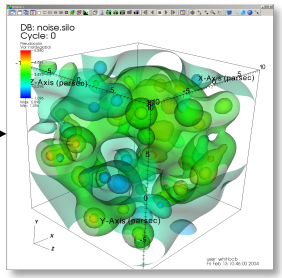
GUI



Python interface



Java interface



# Launching VisIt

- Start menu
- Desktop shortcut
- Double-click VisIt data files
- Double-click VisIt session files

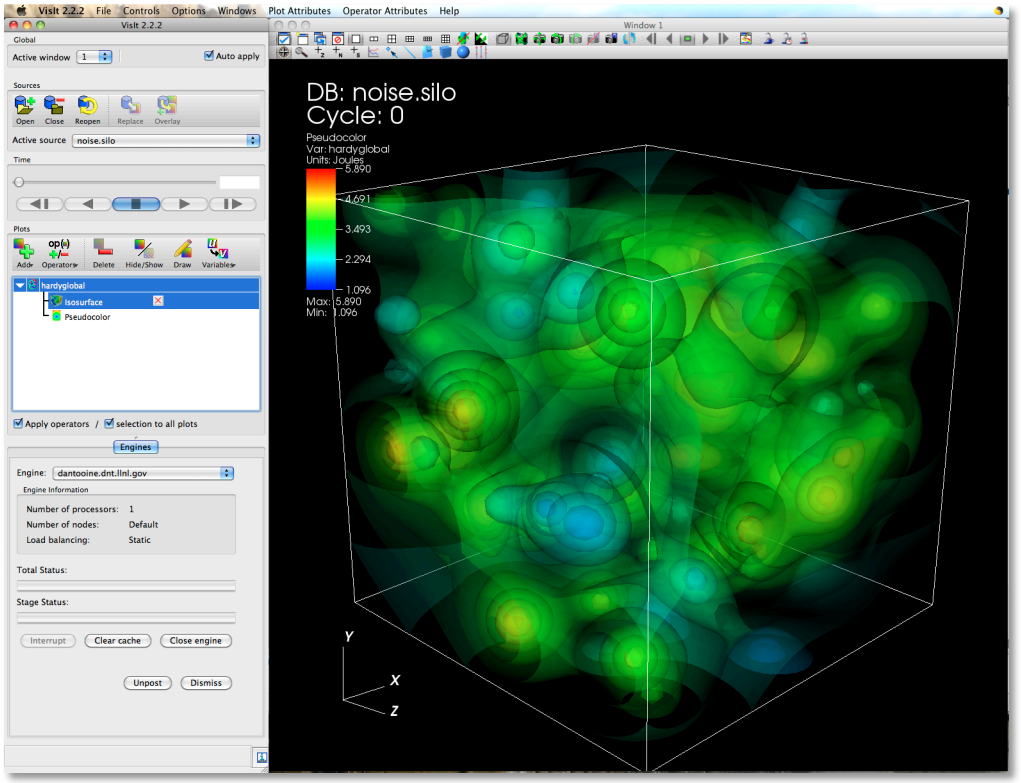
- Type *visit* at command line
- VisIt usually installed in */usr/gapps/visit/bin on LLNL computers*

*If VisIt is not installed, download binaries from*

*https://wci.llnl.gov/codes/visit/*

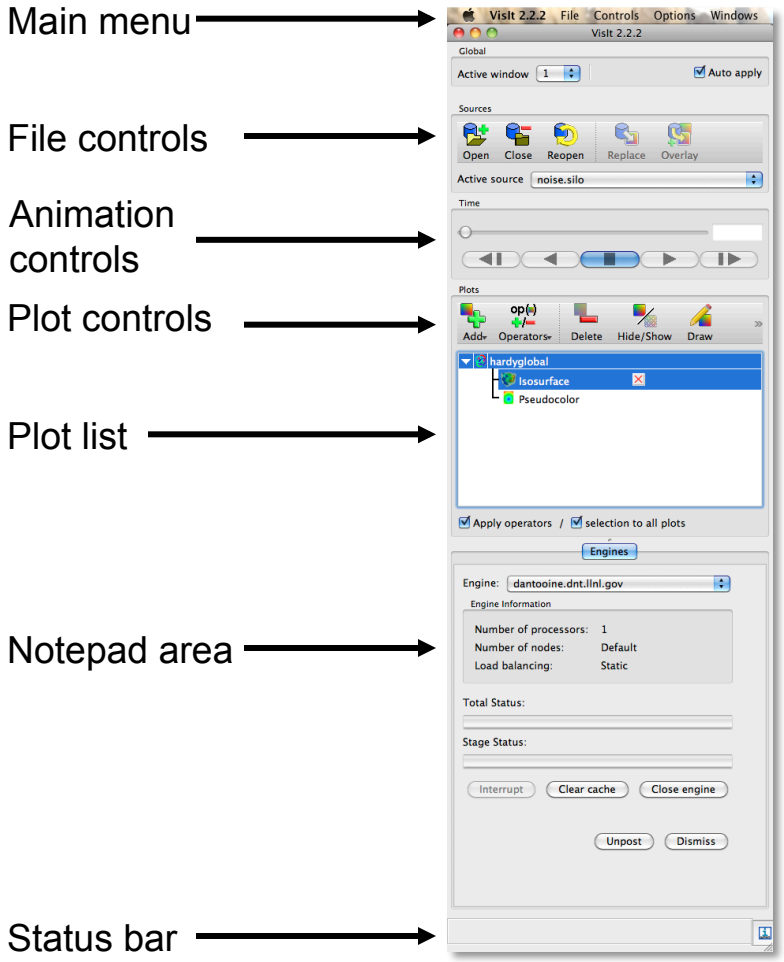
# VisIt's Main Windows

- GUI
  - Select files to visualize
  - Create and manage plots
  - Set plot attributes
  - Add operators
  - Set look and feel for visualization
- Viewer
  - Viewer windows, or vis windows, display all of the data being visualized
  - Mouse navigation
  - Up to 16 vis windows
  - Popup menu
  - Toolbars



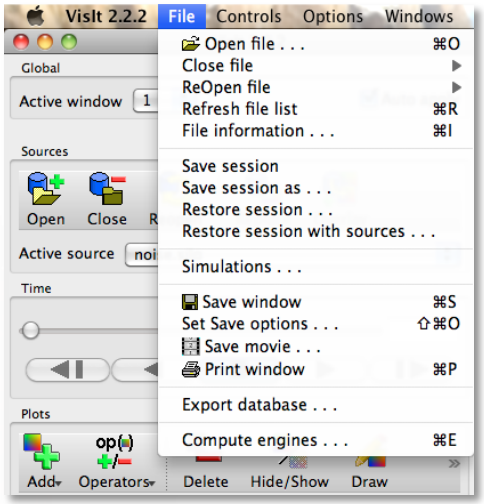
# Main Window

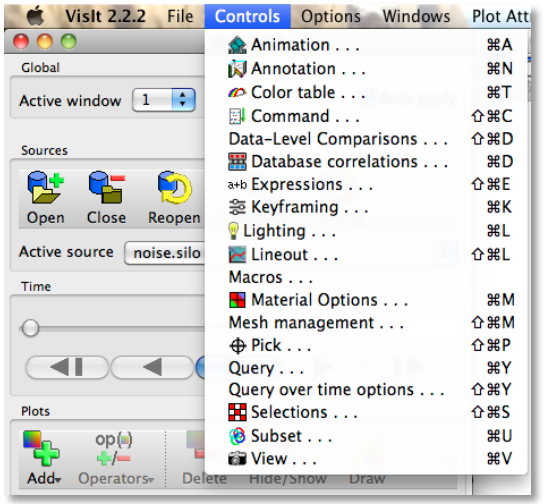
- Main window in GUI
  - Access other important windows
  - Open files
  - Set animation time state
  - Set active window
  - Create and manage plots
  - Displays progress from compute engine

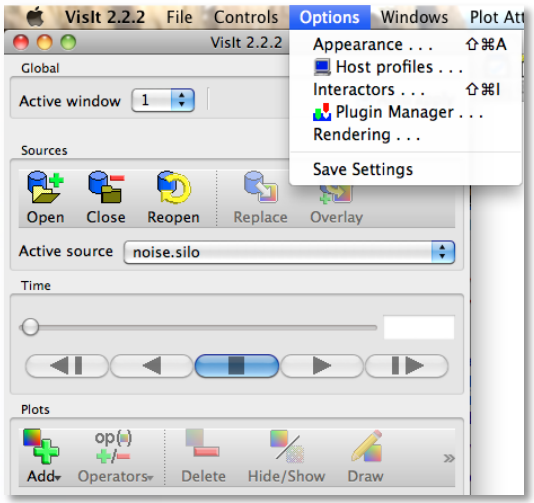


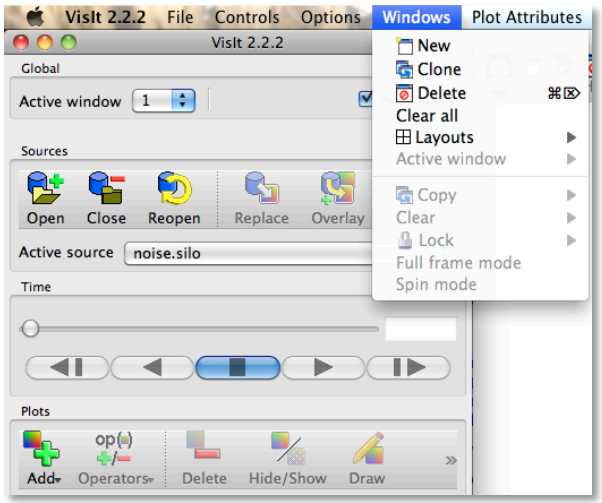
# Main Menu

- Files
- Controls
- Options
- Window
- Plot Attributes *(not shown)*
- Operator Attributes
- Help



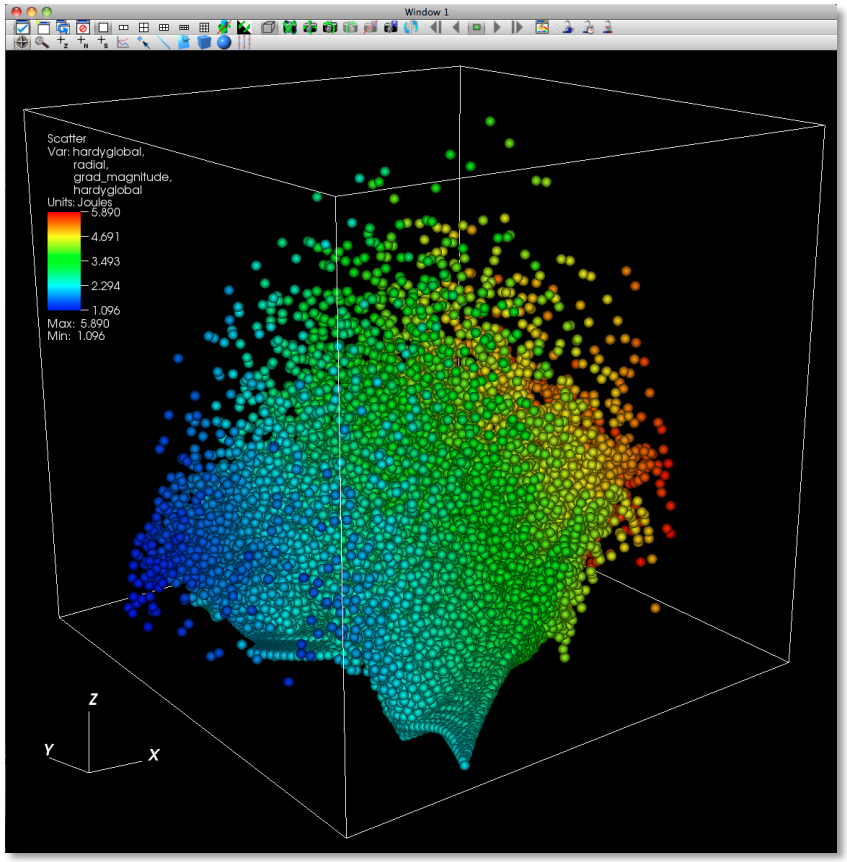



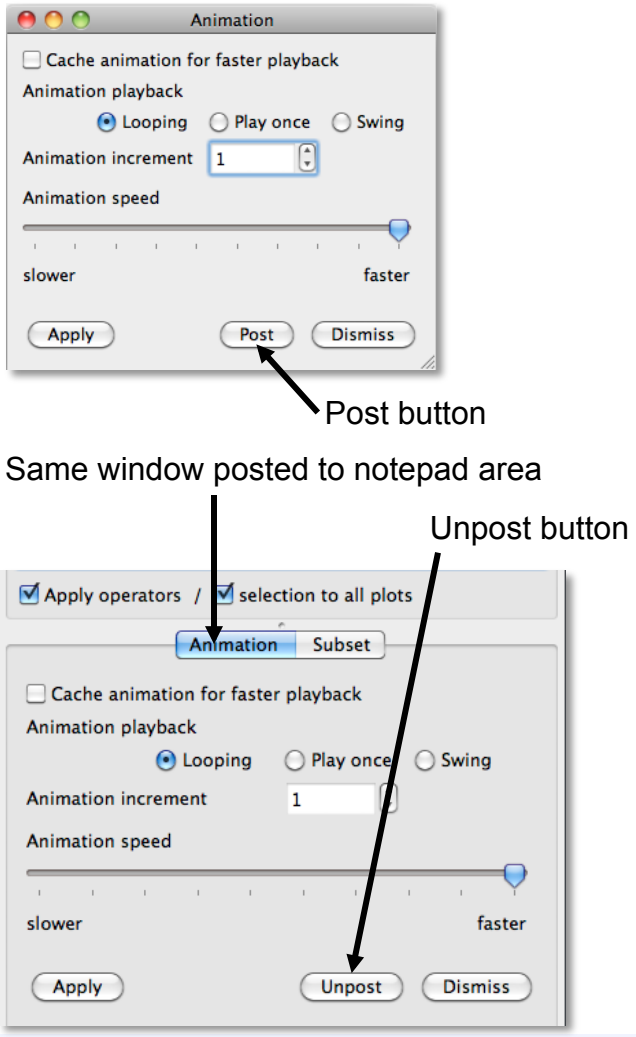
# Visualization Window

- Display plots
- Lets you interact with plots using the mouse
- Toolbars provide shortcuts to common functions
- Popup menu provides same functions as toolbar
  - Right click to activate



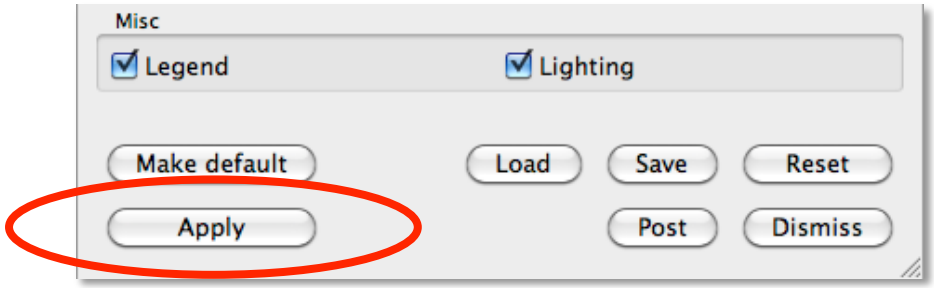
# Posting Windows

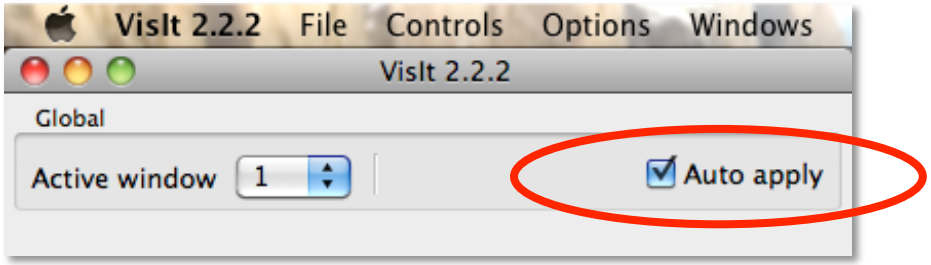
- Postable windows can be docked in to the Main window's notepad area
- Postable windows have a Post button
- Once posted, Post button becomes Unpost



# Applying settings

- Apply button tells VisIt to use new settings
- Auto apply mode applies new settings when you change them
  - No Apply button click required



# How VisIt Works

1. Open database
2. Create a plot
3. Set plot attributes
4. Apply operators to plot to modify data
5. Set operator attributes
6. Compute engine generates plot
7. Plot displayed in vis window

# Working with files

# Lesson Goals

- You will learn how to open data files.
- File types
  - Single time state
  - .visit files
  - Virtual databases
- Source controls
  - Opening files
  - Time controls
  - Reopening files
  - Replacing files
- File Open Window
  - Changing directories
  - Filtering out unwanted files
  - Accessing remote files
- File Information window

# File Types

- Single time step files
  - Simple database files that contain only one time state of data
- *.visit* files
  - Text file that contains the names of single time state files
  - Groups files into time-varying database

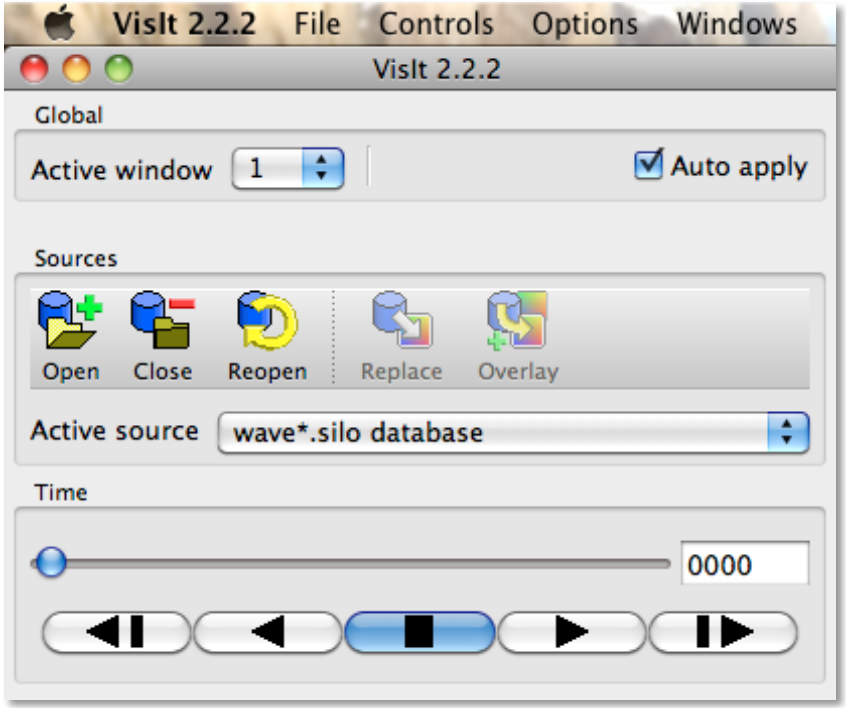
```
File0000.silo
File0010.silo
File0020.silo
File0040.silo
```

```
!NBLOCKS 2
File0000-proc0.silo
File0000-proc1.silo
File0010-proc0.silo
File0010-proc1.silo
```

- Virtual databases
  - Groups files with similar names into a time-varying database
  - Turn off File grouping in File selection window if you don't like it
  - Smart file grouping prevents ALE3D databases ending in .1, .2, .3, … from being grouped into virtual databases

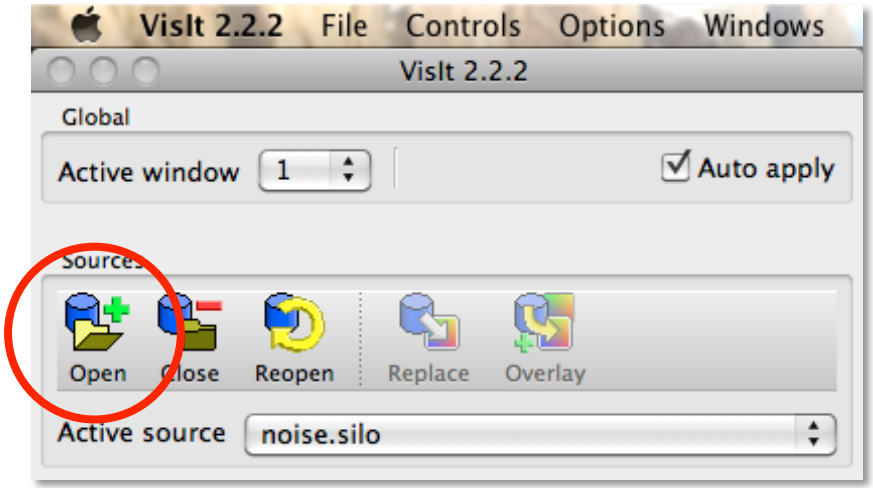
# Source Controls

- Data files or databases are more generally referred to as sources in VisIt
- The Main Window in VisIt contains controls that let you manage sources
- Contains controls to
  - Open sources
  - Close sources
  - ReOpen sources
  - Replace sources
  - Choose the active source



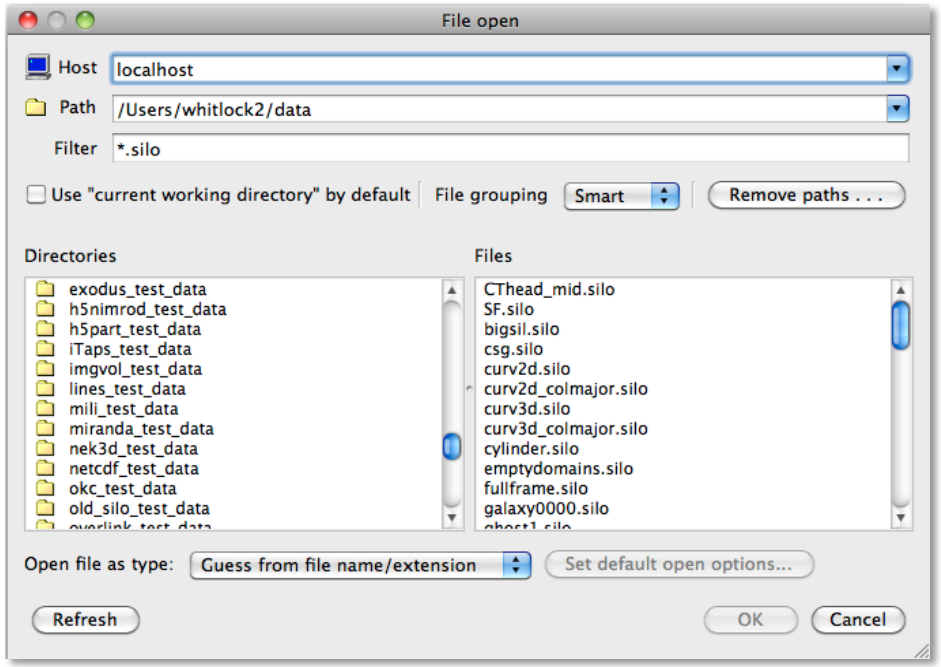
# Opening a File

- To open a new file, click on the Open icon in the Main Window's Source controls
- Once a file is open, the data in it can be visualized
- Click on Reopen to open the file again and regenerate the plots using the file's new data



# File Open Window

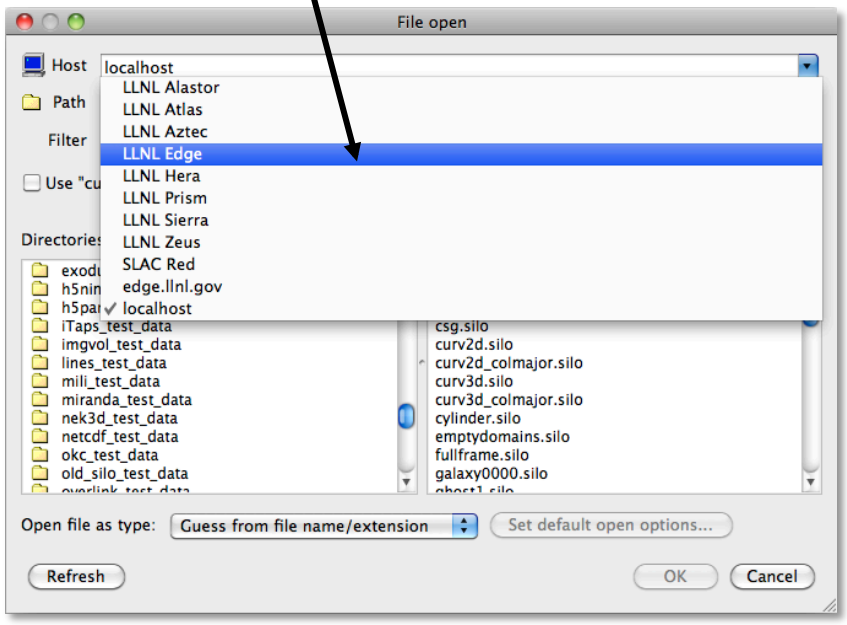
- The File open window lets you browse the file system and open a file
  - Local or remote files
- Filter out unwanted files
- Group related files into time-varying databases
- Force the file to open using a specific reader and set options for the reader



# Changing Hosts

- VisIt can access files that exist on remote computers
- To access remote files, you must change the Host field
  - Type a host name
  - Select the name of a host that VisIt knows about
- VisIt to launches its Database Server on the remote computer so you can browse the remote file system
  - You must have an account on the remote computer
  - VisIt may prompt you for a password to authenticate your access to the remote computer

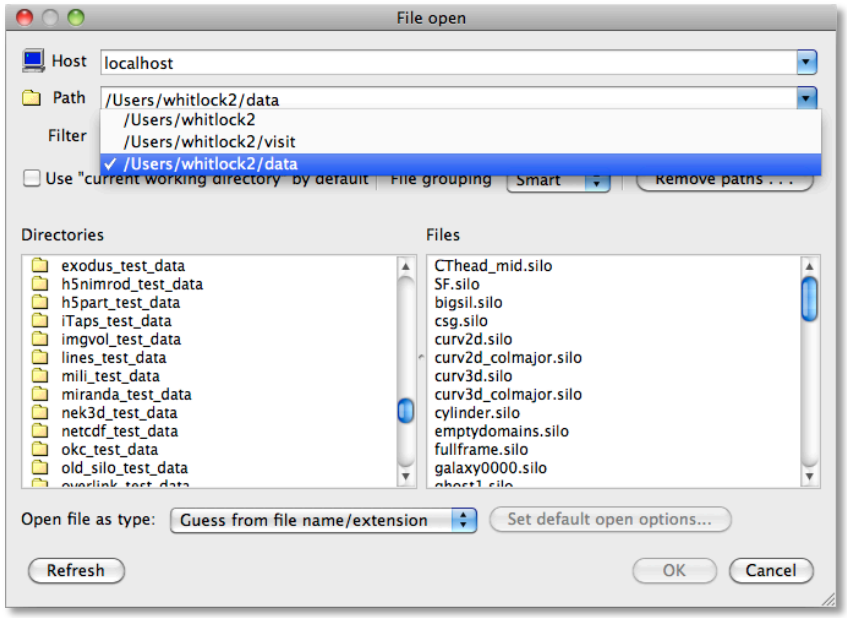
List of hosts in host text field




*The list of hosts can be customized using Host Profiles*

# Changing the Path

- The path is the full name of the directory whose files are displayed in the Files list
- Two ways to change the path
  1. Type the entire path into the Path field and press *Enter*
  2. Double-click on any of the directories in the directory list

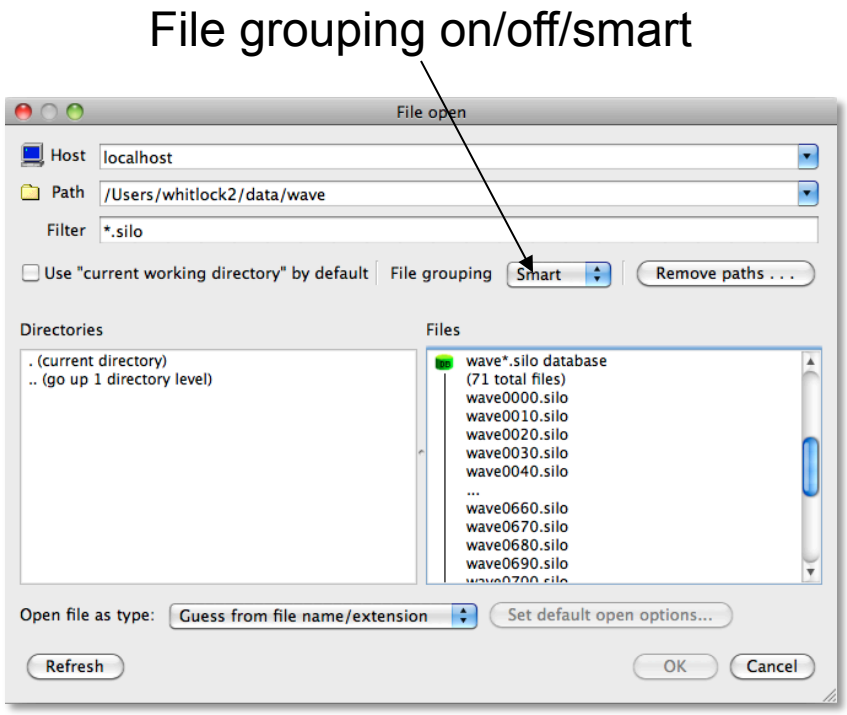


# Changing File Filters

- A filter is a pattern that is applied to the files in the File list to determine whether or not they should show up in the list
- The default filter ("*") shows all files in the file list
- You may specify multiple filters separated by spaces
- Filter wildcards
  - * Allows any string or an empty string
  - ? Allows any single character
  - # Allows any single digit
- Example filters
  - Wave####.silo
  - *.silo
  - BigData.s######

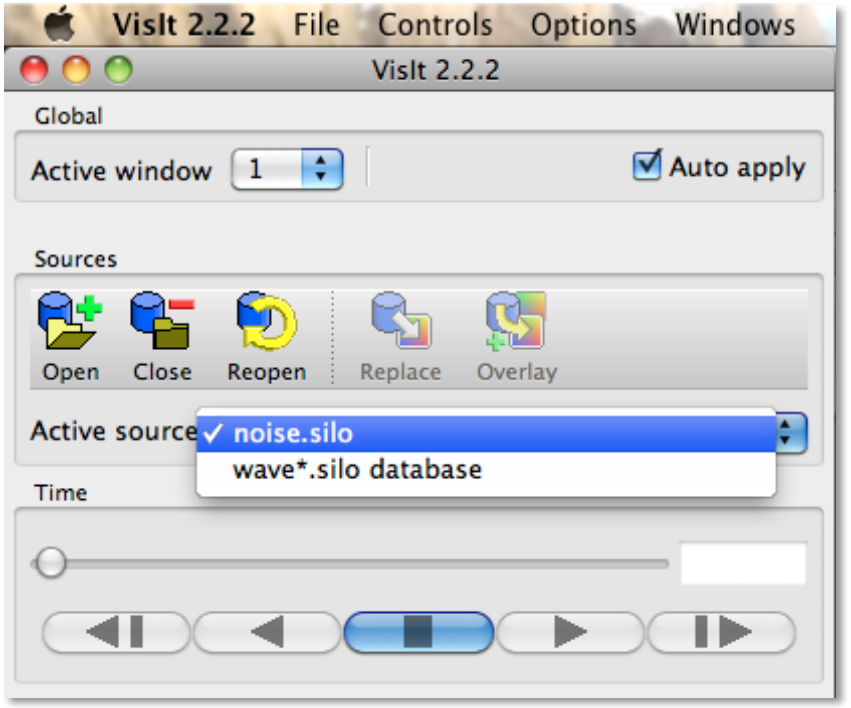
# Automatic File Grouping

- VisIt can automatically group files that have similar names into a single “virtual database”
- A virtual database is like a *.visit* file but VisIt can dynamically add more time states to the file as the simulation writes them
- Automatic file grouping can be turned off if you don’t like what VisIt is doing



# Setting the Active Source

- You can plot data from multiple sources in VisIt
- Each time you open a source, it gets added to the Active source list in the Source controls
- The Active source is used to populate the variable menus for plots
- Select a source from the Active source list to set the active source

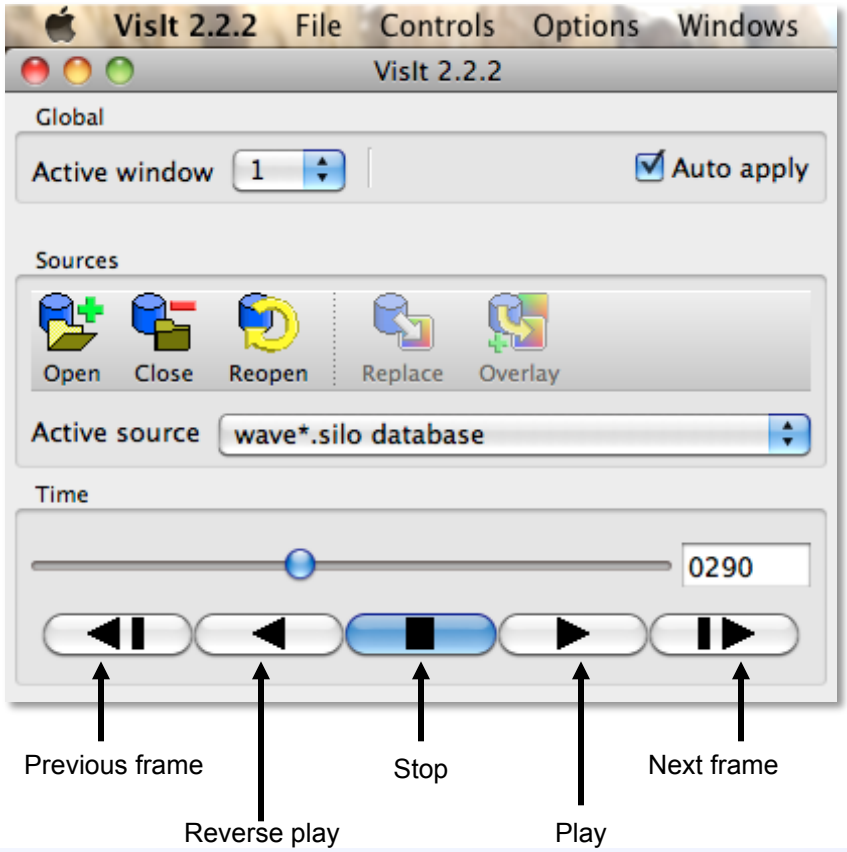


# Replacing a Database

- Open a new source
- Click the Replace button to replace the existing plots with the new source's data
  - The new source must have compatible variables

# Setting the Active Time Step

- The active time step is a file within a time-varying database that VisIt will use to generate plots
- The Main Window contains Time controls which allow you to set the active time step used for visualization
  - Animation slider and Animation Text Field show the active time step
  - Animation Slider sets the time step
  - Type a time or cycle number into the Animation Text Field to set the active time step
  - Multiple time sliders are supported
- VCR Controls let you play and step through animations

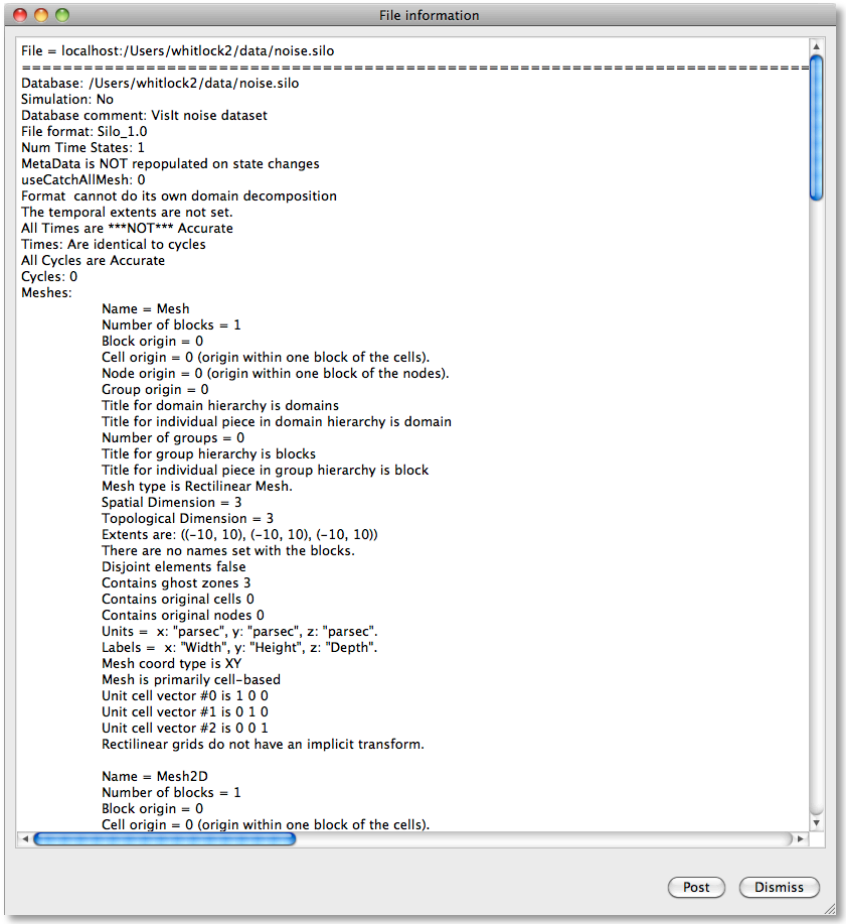


# Closing Databases

- Closing a database frees resources
- Set the active source to the database you want to close
- Click the Close button in the Source controls
- Databases will only close if they are not referenced by plots

# File Information Window

- The File Information window displays information about the active source
  - Meshes
  - Variables (scalars, vectors, etc)
  - Materials
  - Species
- Choose the Files Information option from the Main Window's File menu to open this window



# Exercise Group 1

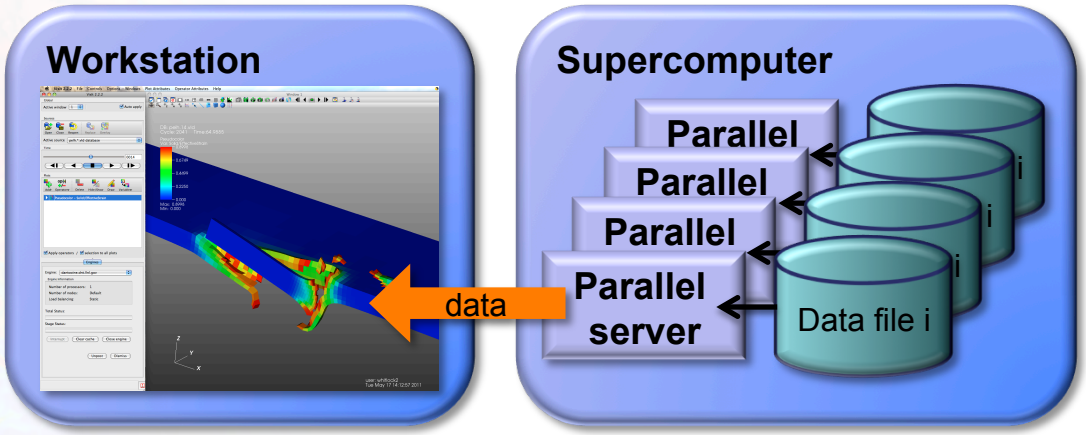
LLNL-PRES-484817

# Client/Server Visualization

# Overview of Client/Server Visualization

- Databases reside on the supercomputer that generated the data
- Run VisIt client on a local workstation
- Connect to server on computer that generated data

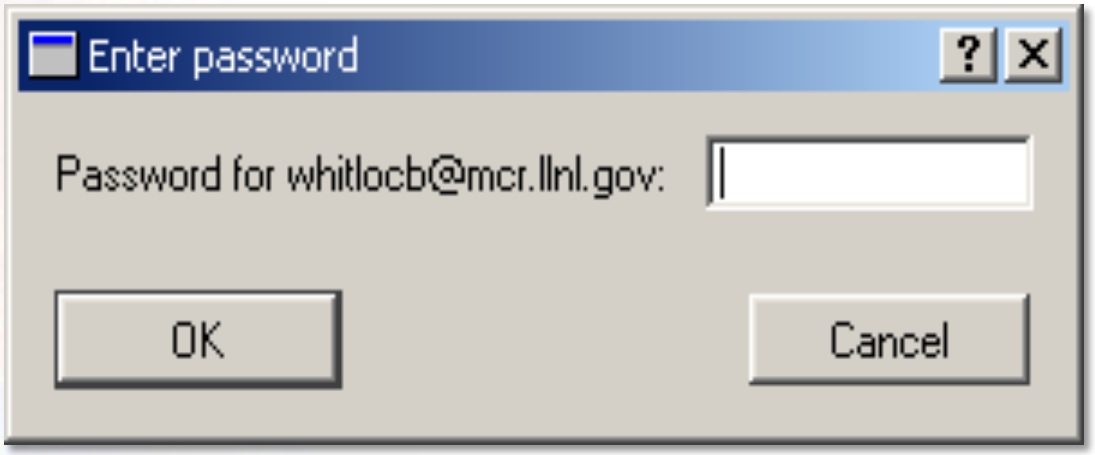
- Advantages
  - Moving data is not necessary
  - No performance degradation due to encryption of X11
  - Avoids inadequate X-servers (xwin32)



# Passwords

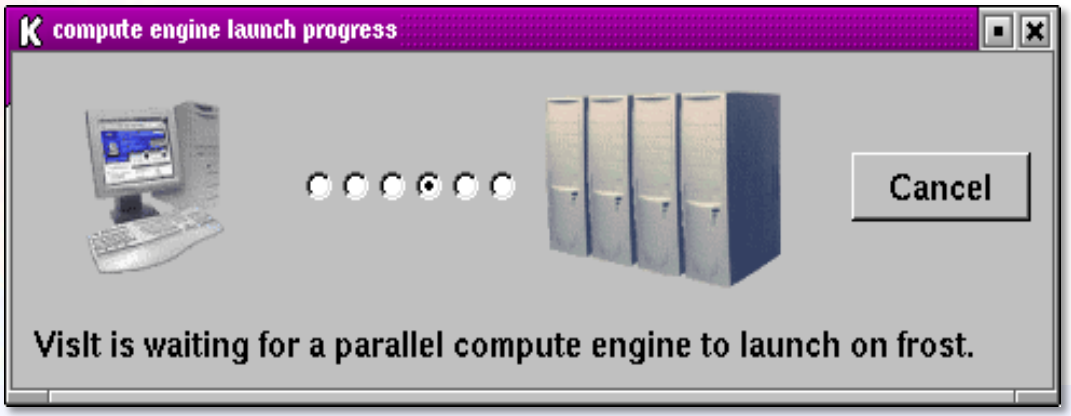
- Sometimes when you try to access files on a remote computer, VisIt prompts you for a password, opening a Password Window
- When prompted, enter your password and click the *OK* button or press the *Enter* key to proceed

Password Window



# Connection Progress Dialog

- The Connection progress window is opened when a parallel compute engine cannot be launched after a few seconds
  - Shows VisIt is waiting for an engine connection
  - Provides a Cancel button if you want to stop waiting
  - Clicking the Cancel button does not remove the job from the queue

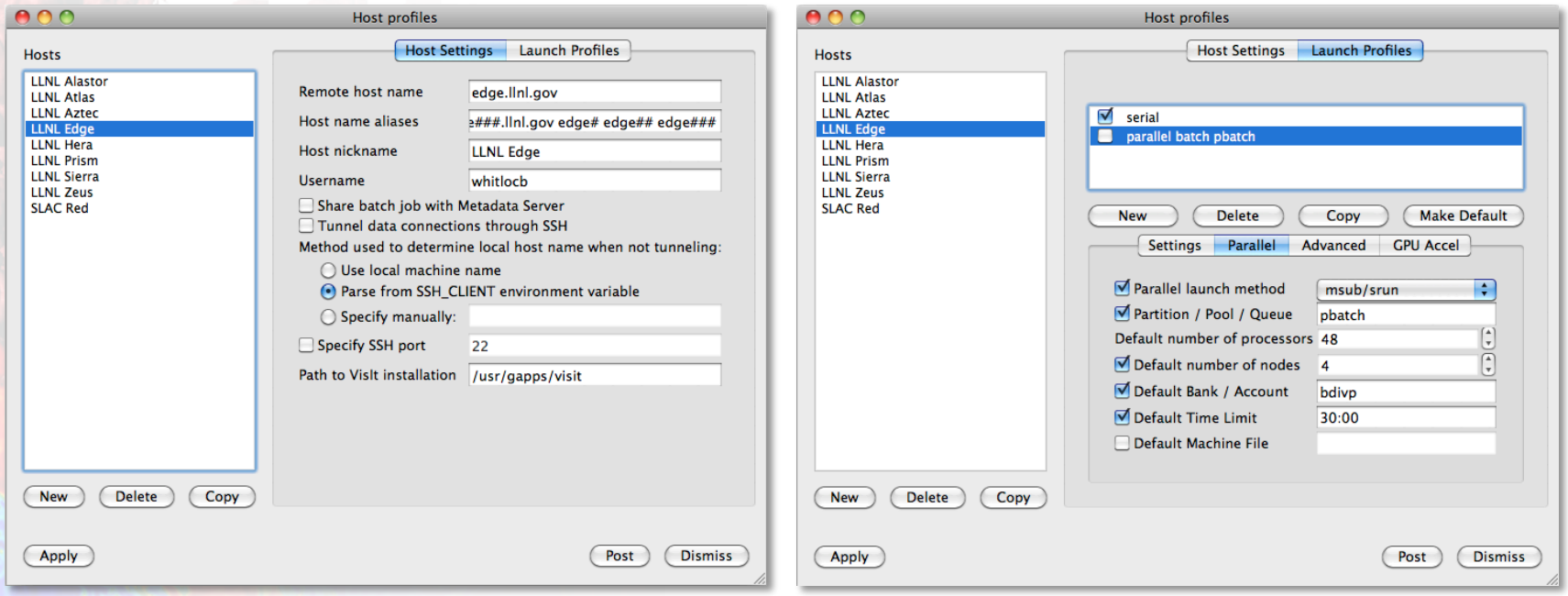


# Host Profiles

- Host profiles contain information needed to launch on remote computers
  - remote user name
  - number of processors
  - parallel launch method
  - *(many other options)*
- You may also have multiple host profiles for any given computer
  - Common to have separate host profiles for running VisIt in serial and parallel
- Host profiles are predefined for sites like LLNL, ORNL, LBL, etc.

# Host Profile Window

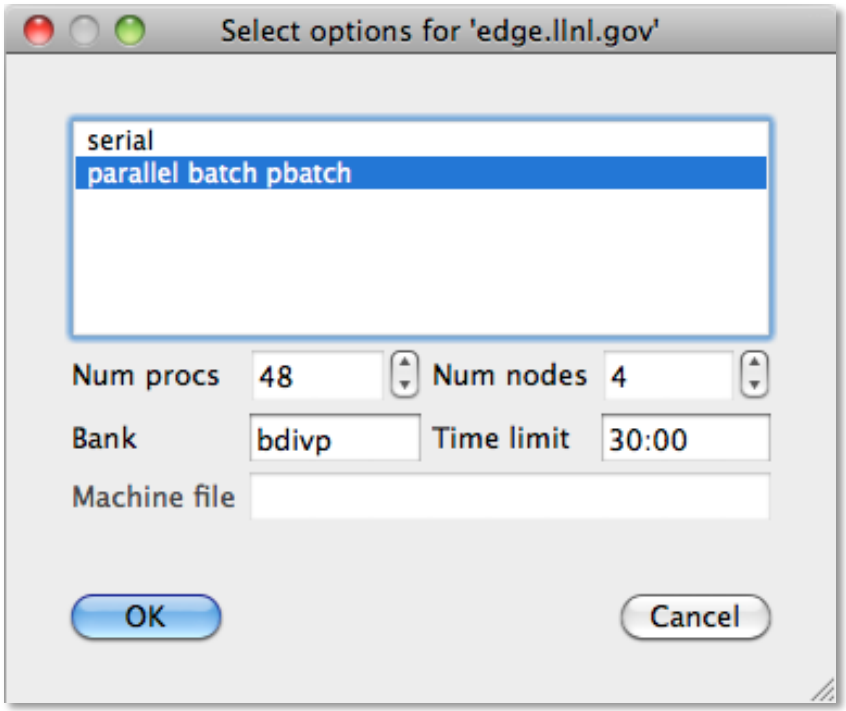
The Host Profile Window lets you manage profiles that let you launch VisIt on multiple computers.



# Engine Option Window

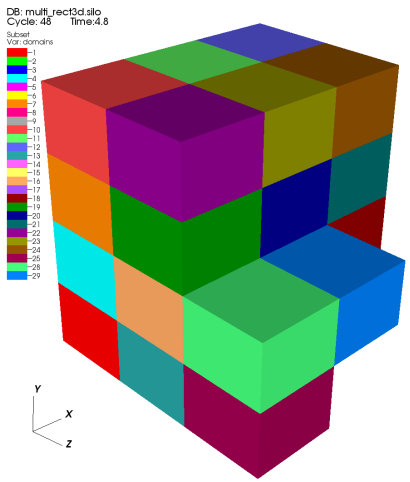
- This window provides a list of host profiles from which to choose
- Last chance to alter parallel launch settings for the selected host profile
- Click the *OK* button to confirm your choices or changes
- Cancel the engine launch

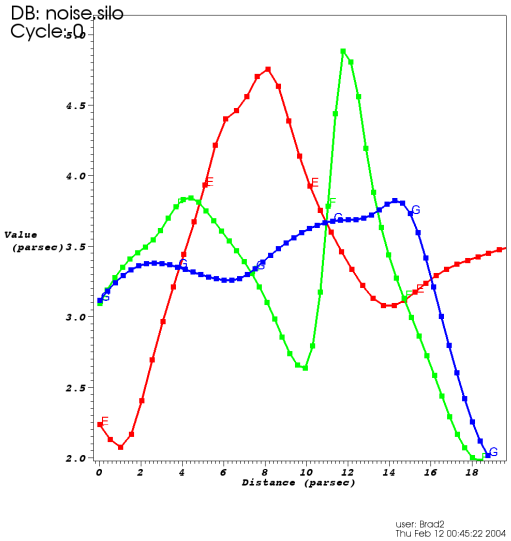
Engine Option Window

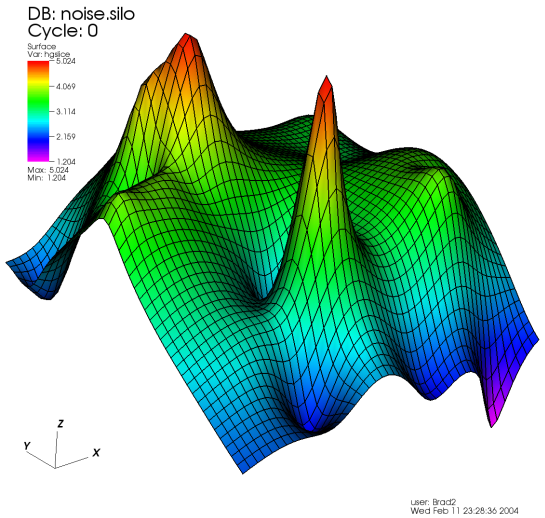


# Exercise Group 2

# Plots


DB: multi_rect3d.silo
Cycle: 48 Time:4.8
Subset
Var: domains
Y
X
Z


DB: noise.silo
Cycle: 0
Value (parsec)
Distance (parsec)
user: Brad2
Thu Feb 12 00:45:22 2004

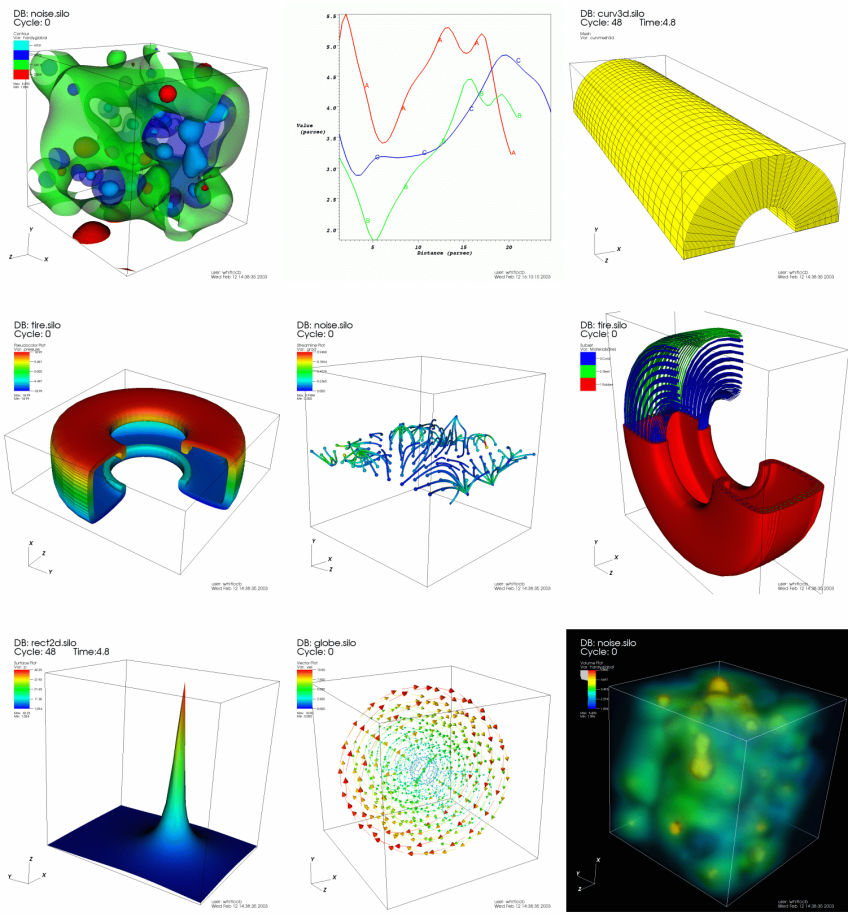

DB: noise.silo
Cycle: 0
Surface
Var: hgslice
5.024
4.069
3.114
2.159
1.204
Max: 5.024
Min: 1.204
Z
Y
X
user: Brad2
Wed Feb 11 23:28:36 2004

# Lesson Goals

- By the end of this lesson, you will know:
  - How to create and manage plots
  - The purpose for each plot
  - When and how to use each plot

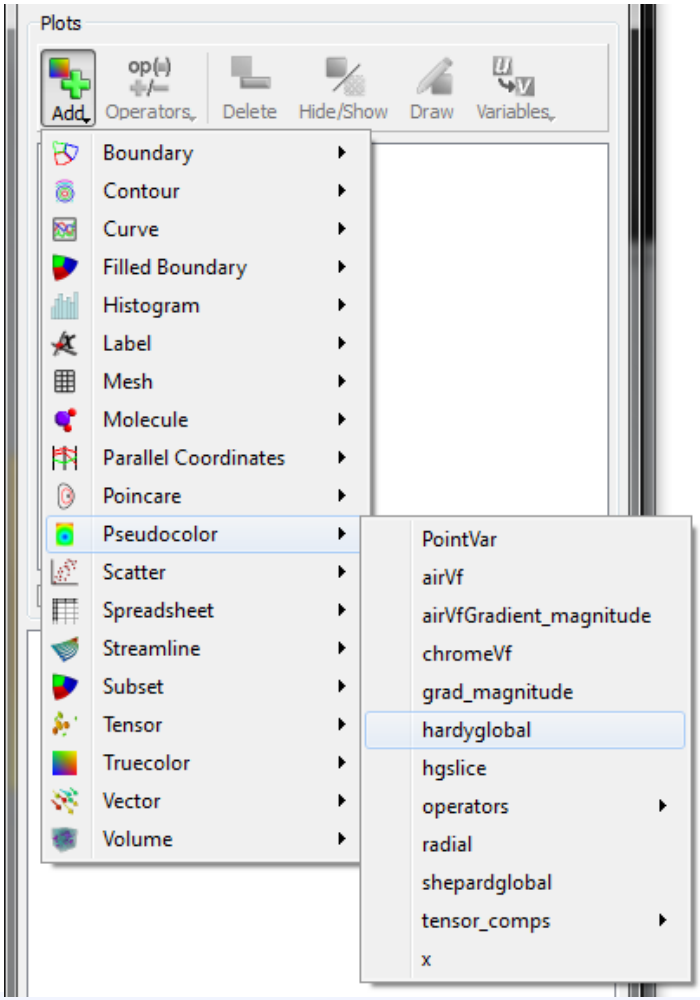
# What is a Plot?

- A plot is a viewable object, created from a database, that can be displayed in a visualization window
- VisIt has several types of plots, including: Pseudocolor, Mesh, Volume, Subset…
- Plots come from plug-ins so you can extend VisIt's plotting capabilities by writing a new plug-in



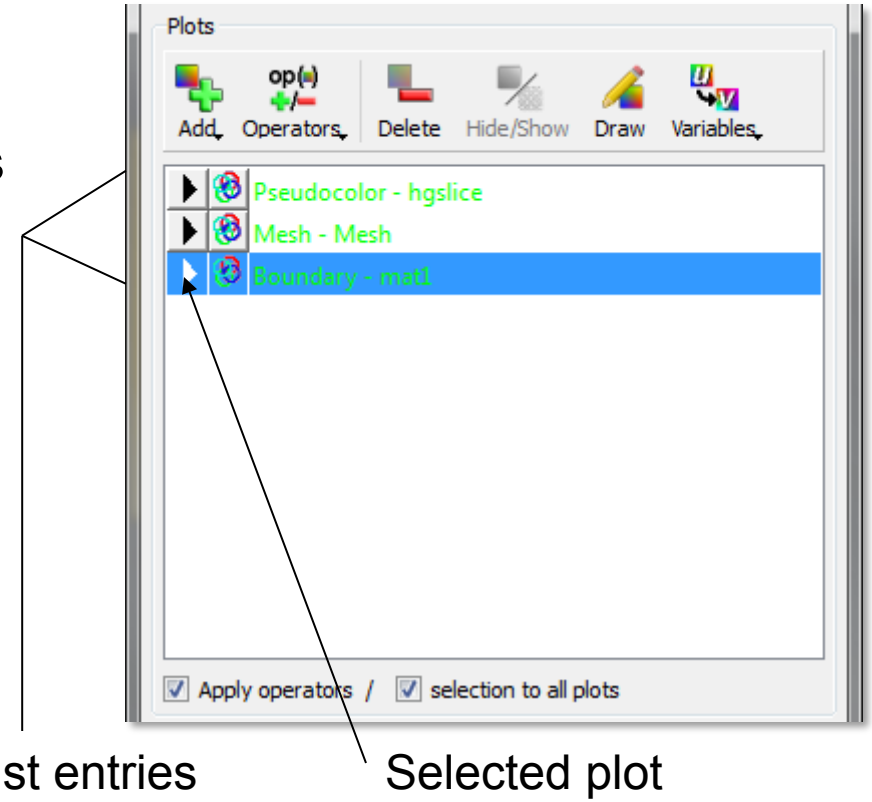
# Creating a Plot

- After opening a database the Add plot menu will be enabled
- Select a variable from a plot's variable menu to add a new plot
- Each plot's variable menu will expose the variables that it can use



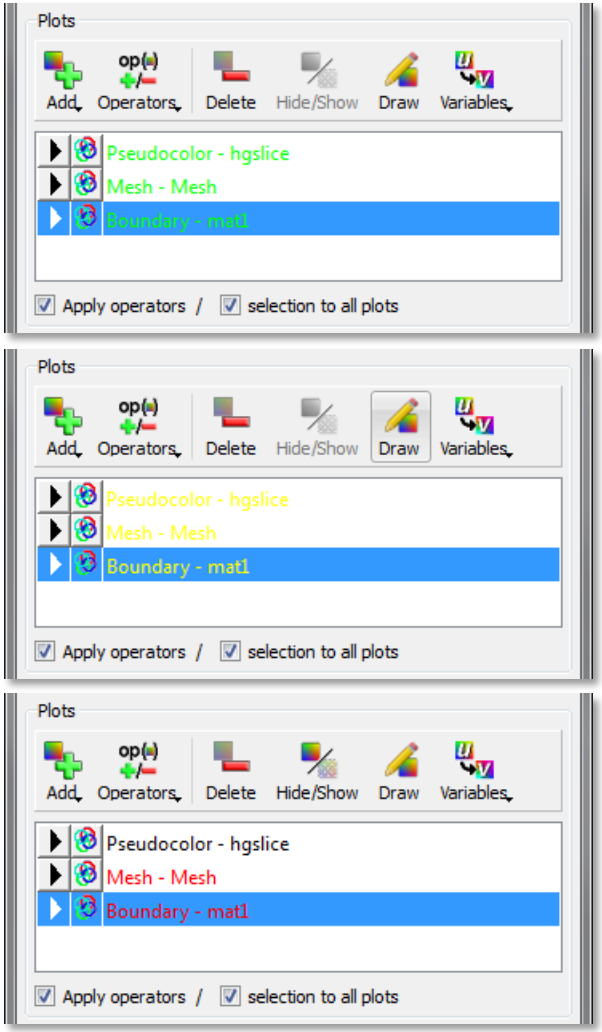
# The Plot List

- The plot list shows the plots for the active vis window
- Each plot has an entry in the plot list
- A plot list entry shows a plot's
  - Name
  - Variable
  - Database
  - Completion state
  - Applied operators



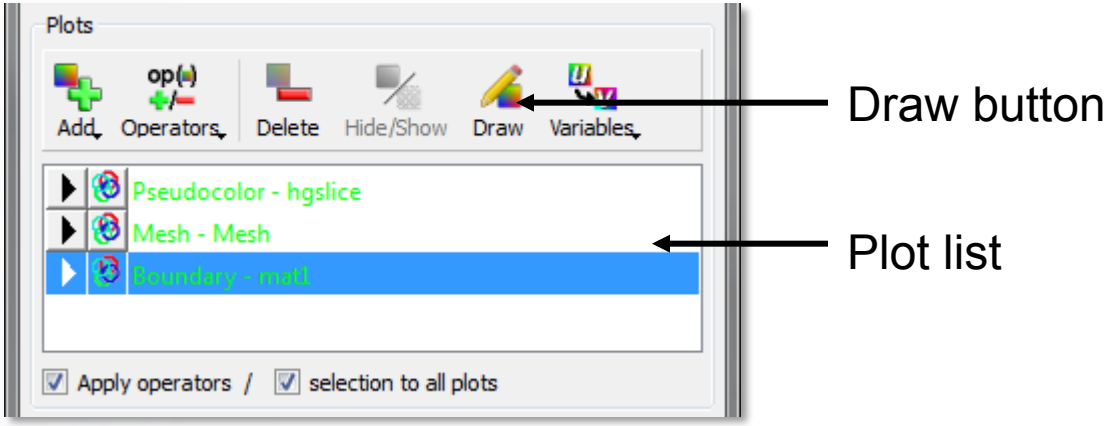
# Plot States

- Plots can have the following states:
  - New
  - Pending
  - Complete
  - Error
- New plots are green
  - Not yet sent to the compute engine for processing
- Pending plots are yellow
  - Sent to the compute engine but they are not complete
- Completed plots are normal text color
  - Successfully processed by the engine
- Plots in the error state are red
  - Could not be generated by the compute engine due to invalid inputs or an unexpected error



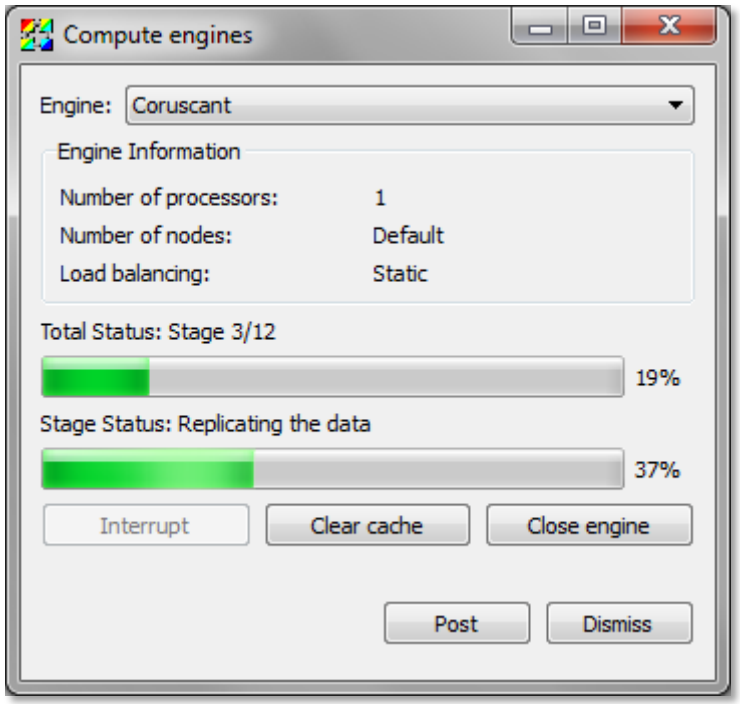
# Drawing a Plot

- New plots are in the “new” state
- Click the “Draw” button to make VisIt generate the plot
- Change plot attributes before generating the plot to make VisIt go faster
- Auto apply mode can make the plot generate once it is created so clicking “Draw” is not required



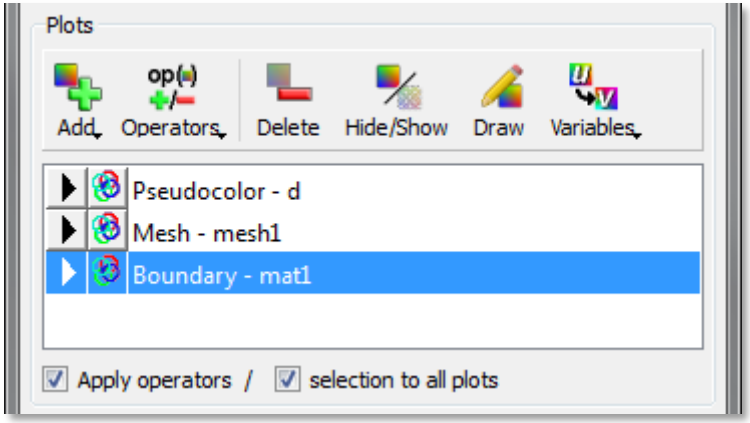
# Plot Feedback

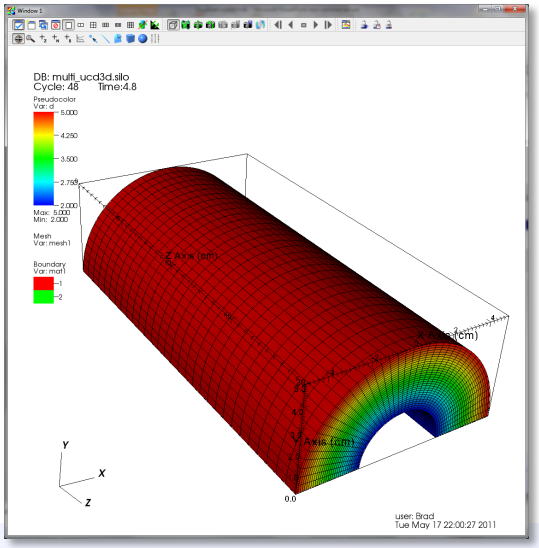
- VisIt provides feed back about plot execution in the status bar and in the Compute Engines window
  - Display the compute engine's resources
  - Clear the compute engine's data cache
  - Close a compute engine
- Activate the Compute Engines window from the File menu in the Main window



# Completed Plots

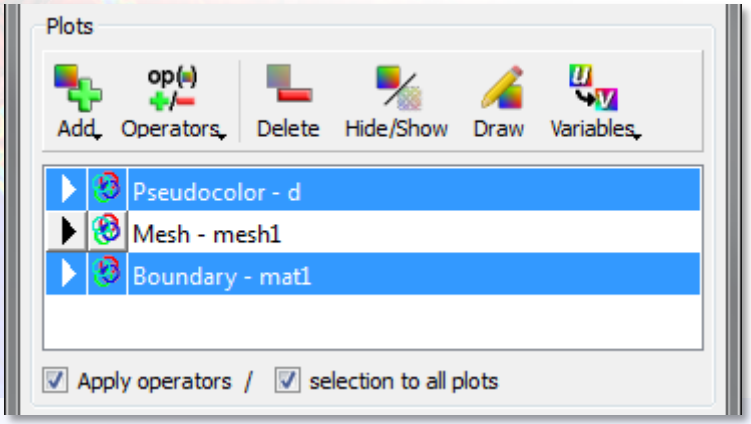
- When plots are completed without errors, their entries in the plot list are drawn with the normal text color
- Completed plots appear in the vis window



# Selecting Plots

- VisIt operates on the selected plots
- The list of selected plots is used in:
  - Hiding or showing plots
  - Deleting plots
  - Setting plot attributes
  - Picking on plots



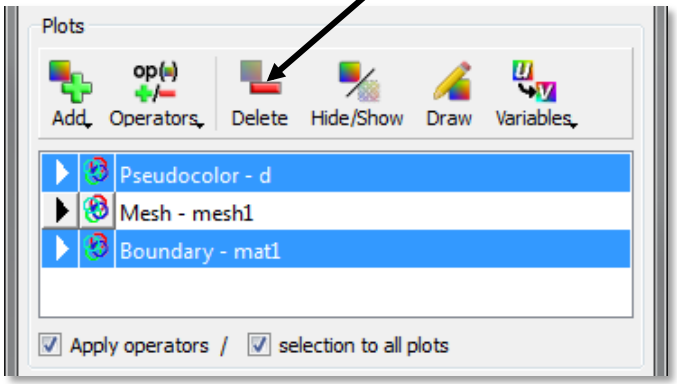

- Select a plot by clicking on it
- Select multiple consecutive plots
  - Click on one plot and drag
  - Or, click on the first plot you wish to select and hold down *Shift* and click on the last plot to select
- Select multiple plots
  - Hold down *Ctrl* while you click on the plots that you want to select

# Deleting Plots

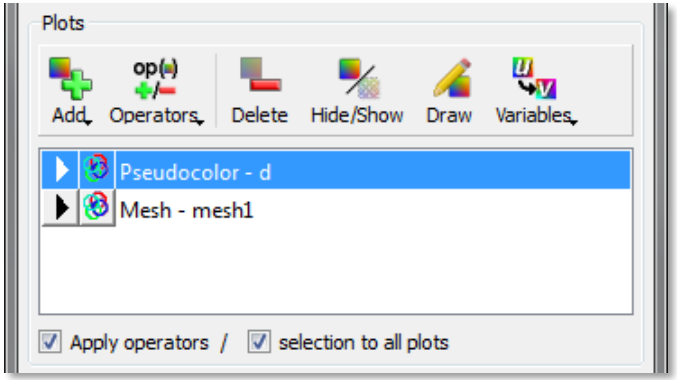
- Deleting a plot
  - Removes its plot entry from the plot list
  - Frees up resources used by the plot
  - Removes the plot from the vis window
  - Selects the first plot
- How?
  - Select the plot
  - Click the Delete button

Delete button

Before deleting plot

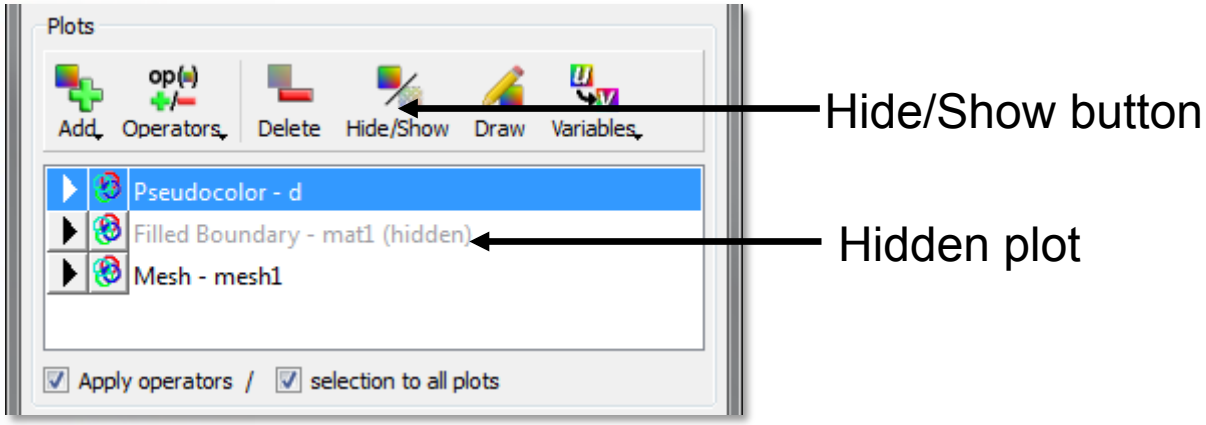



After deleting plot



# Hiding Plots

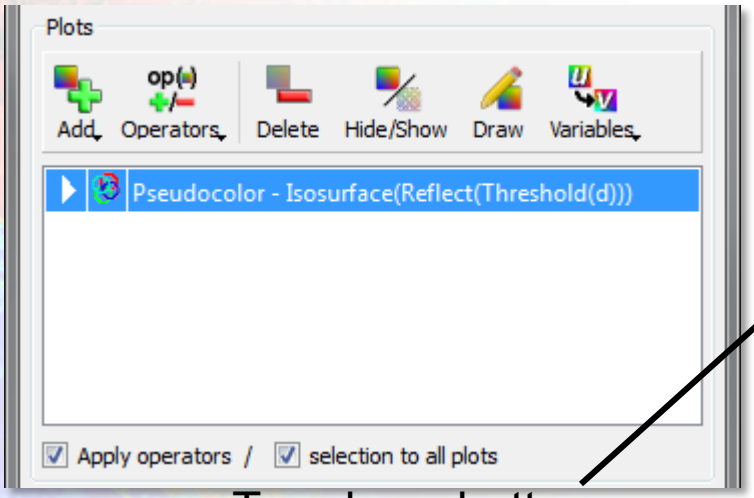
- It is often useful to hide plots in the plot list
- Hiding a plot lets you view another plot that exists in the same space without having to delete the first plot
- How?
  - Select plots to be hidden
  - Click the Hide/Show button



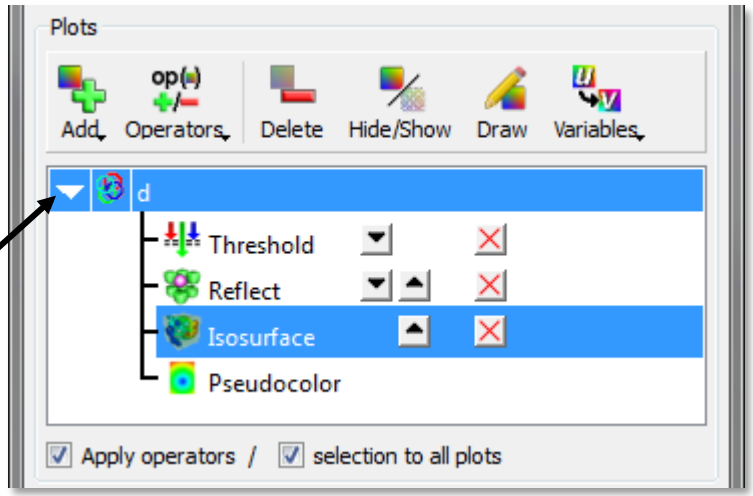
# Expanding a Plot Entry

- Each plot entry in the plot list can be expanded so you can see more information about the plot
- To expand a plot entry, click on its turndown button
- Expanding a plot entry has no effect on the plot other than to allow you to view more of its attributes

Collapsed plot entry



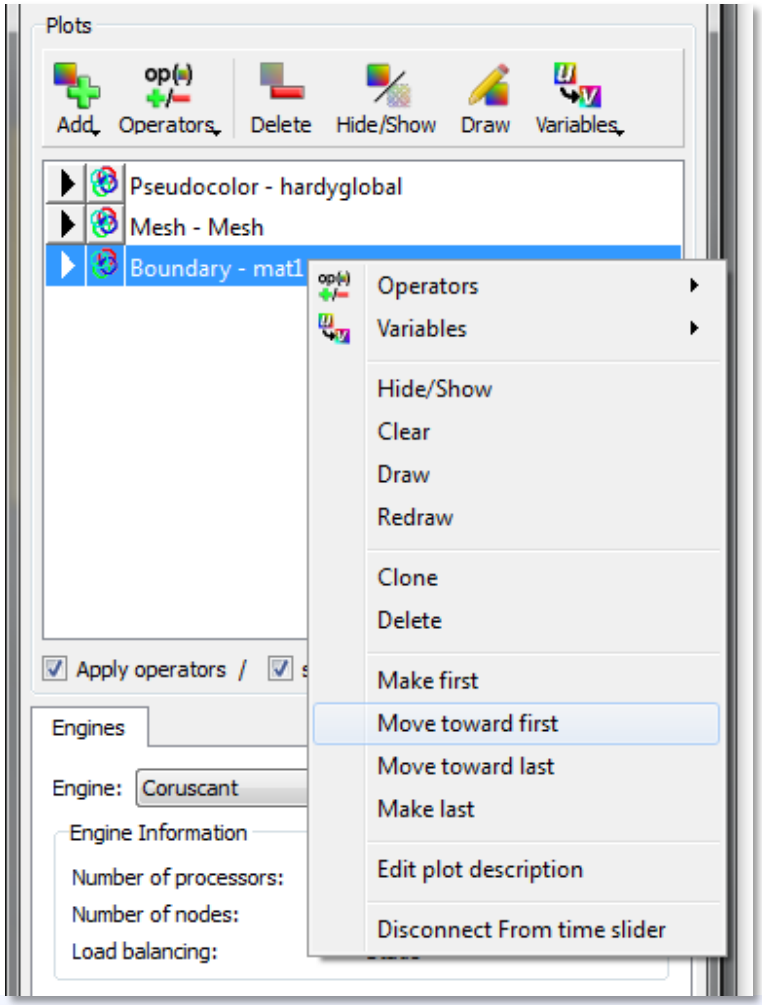

Expanded plot entry




Turndown button

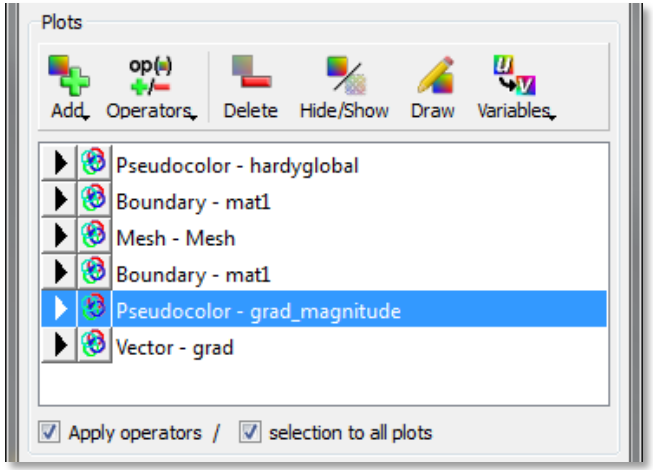
# Changing Plot Order

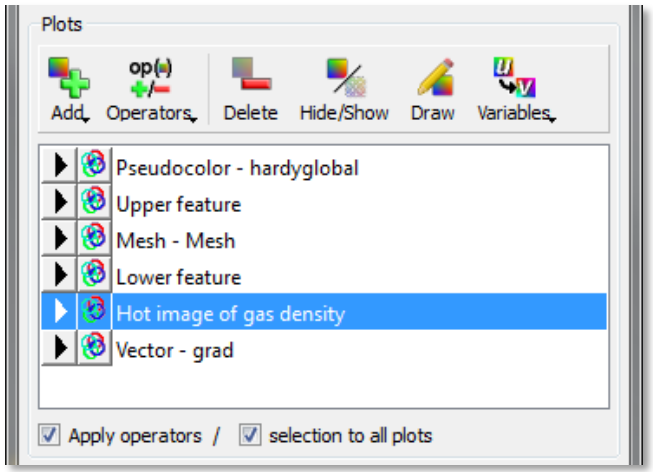
- Plots can be reordered in the plot list
- Right click on a plot to access its context menu
  - Make first
  - Move toward first
  - Move toward first
  - Make last



# Add a Plot Description

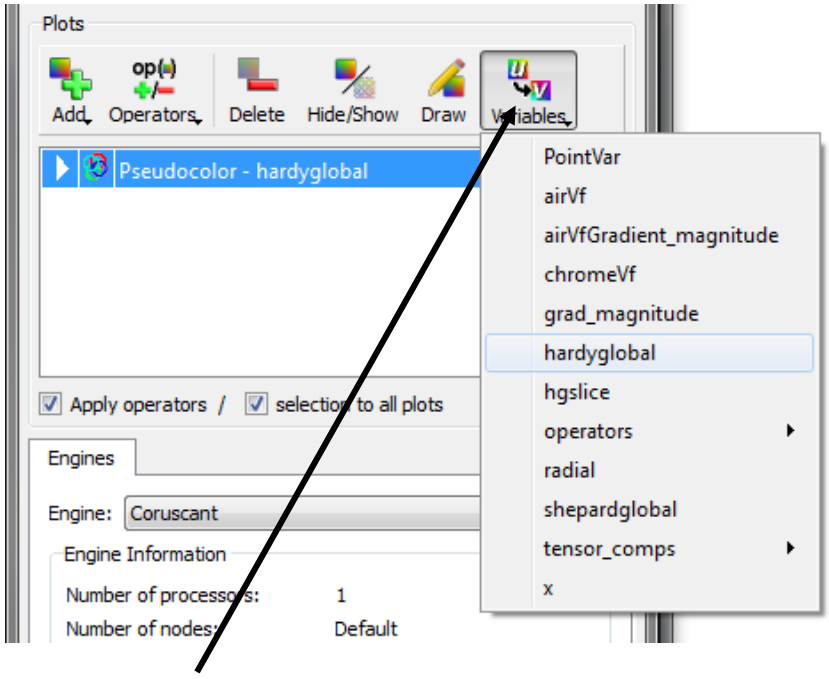
- When using several plots at once it can be difficult to remember which plots correspond to features in the visualization
- Add a description of the plot so you can identify it
- Right click on the plot to access the context menu and edit the plot description



# Changing the Plot Variable

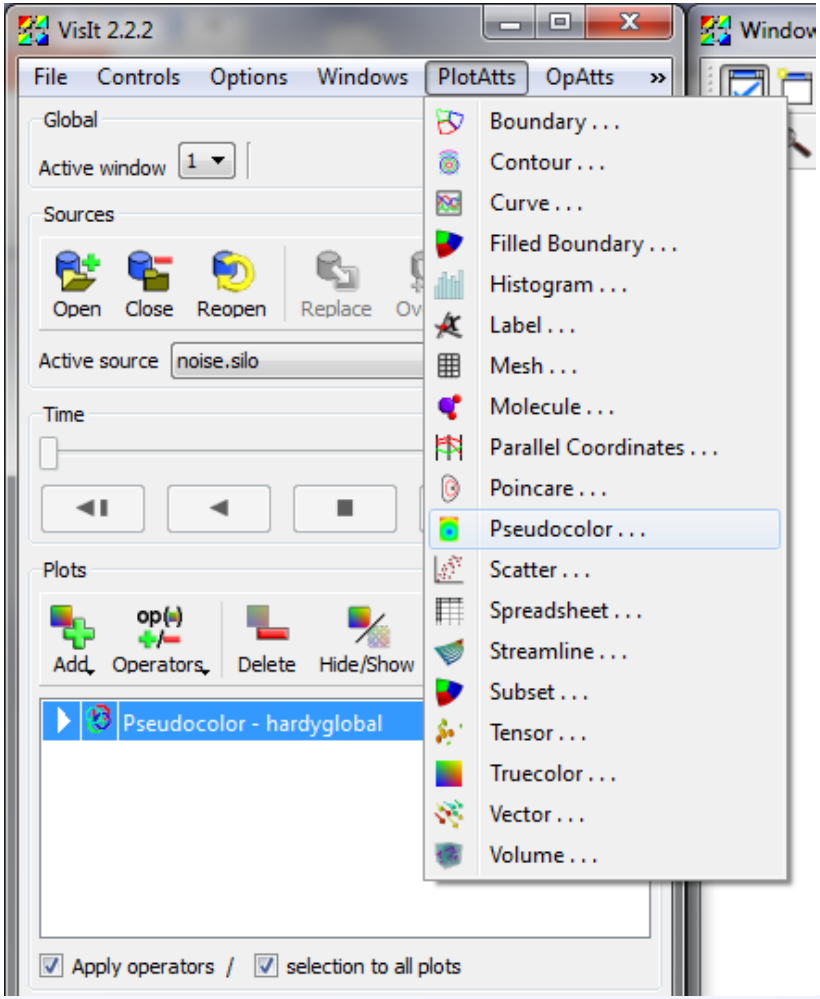
- The variable menu only contains variables that can be plotted by the selected plot
- Select a new variable from the menu to change the selected plot's variable
- If there is no selected plot, the variable menu is disabled




Variable menu

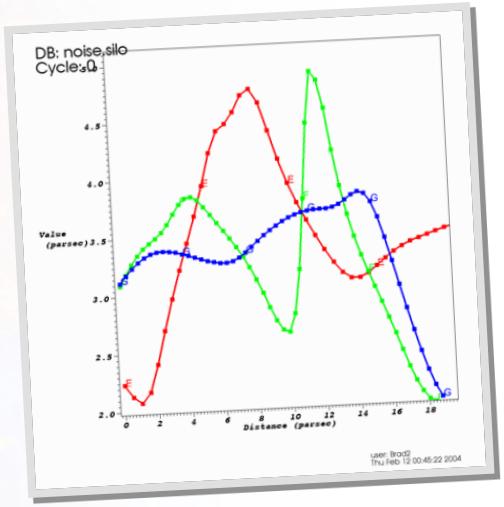
# Setting Plot Attributes

- The Plot attributes menu provides buttons to activate the plot attribute windows
- Double-clicking on a plot also activates its plot attributes window
- Plot attribute windows set the plot attributes for the selected plots
- Each plot type has a single plot attribute window
- To change the plot attributes:
  - Select the plot that you want to modify
  - Open its plot attributes window
  - Change some plot attributes

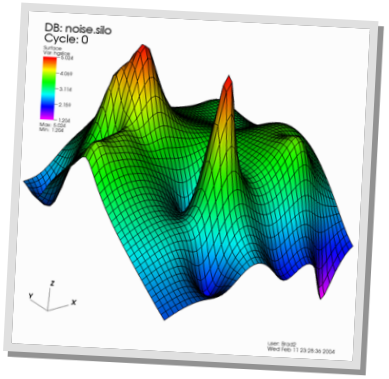


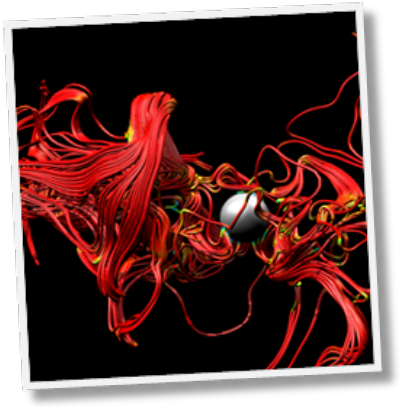
# Plot Types

- We will now examine each plot in more detail so you know when to use it and how to set its attributes using its plot attribute window



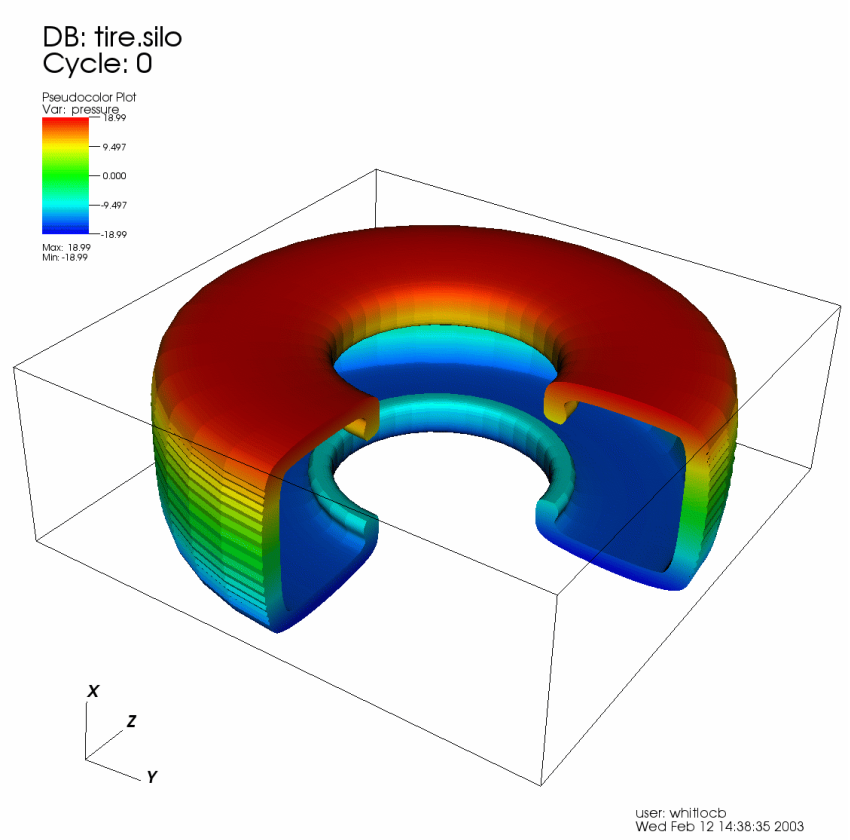

- Plots
  - Pseudocolor
  - Mesh
  - FilledBoundary
  - Boundary
  - Contour
  - Volume
  - Vector
  - Spreadsheet
  - ParallelCoordinates
  - Subset
  - Streamline
  - Curve
  - Histogram
  - Tensor
  - Molecule
  - Truecolor
  - Scatter



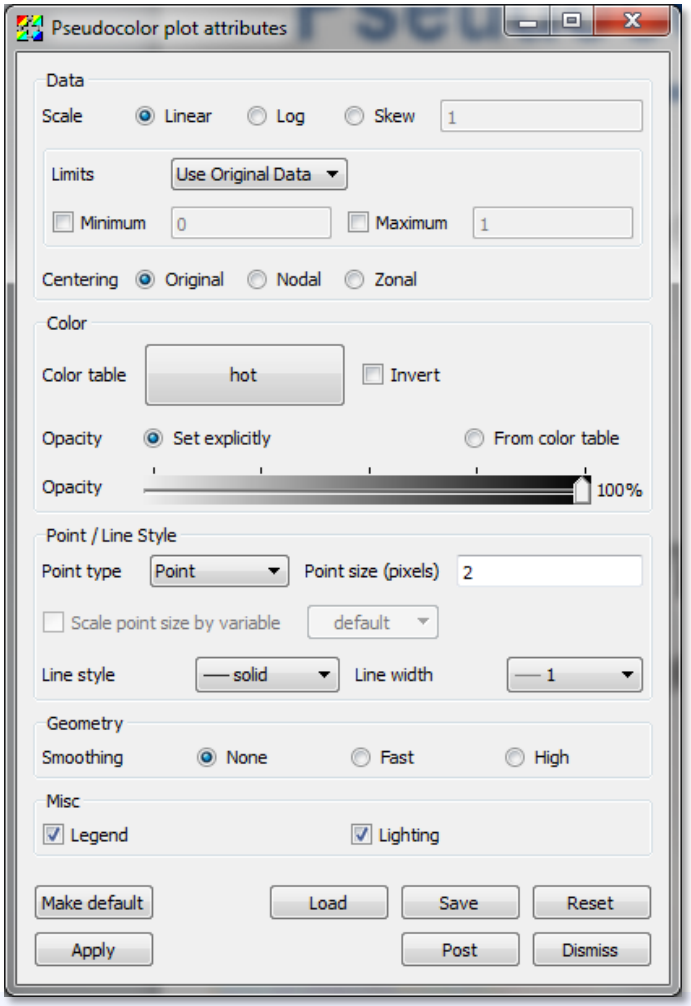
# Pseudocolor Plot

- This plot maps a scalar variable to colors and uses the colors to “paint” values onto the variable’s mesh
- Use this plot when you want to investigate the behavior of a scalar variable
- This plot accepts scalar variables



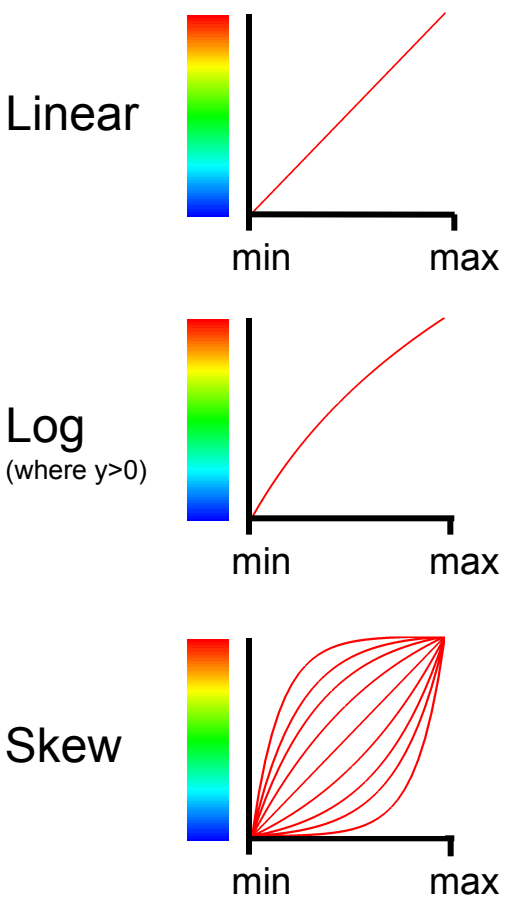
# Pseudocolor Plot Attributes

- Data
  - Scaling
  - Limits
  - Centering
- Color and opacity
- Point / Line Style



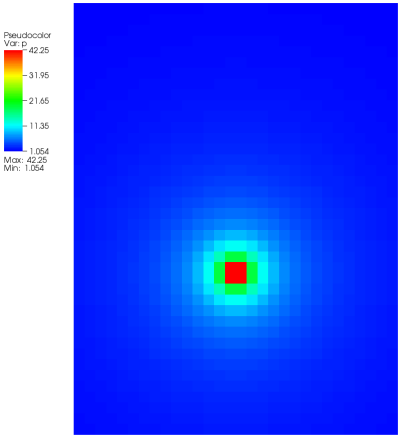
# Scaling

- Scaling tells VisIt how to map values to color
- Linear scaling maps data range evenly to color range
- Log scaling assigns more low data values to color range
  - Values must be greater than 0
- Skew scaling can assign either high or low values to color range using a skew factor

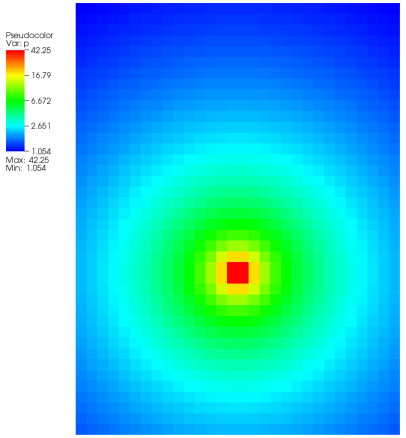


# Scaling

Linear scaling

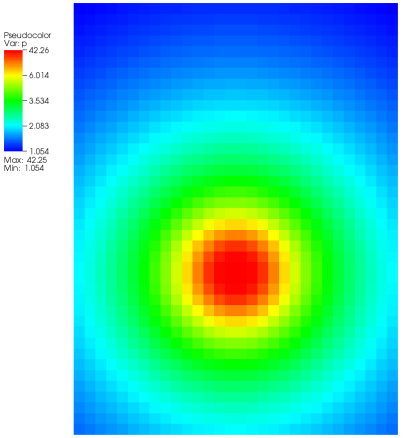



Log scaling



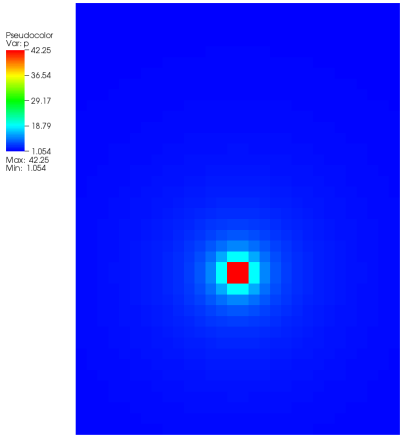

Skew scaling

Skew factor=0.00001



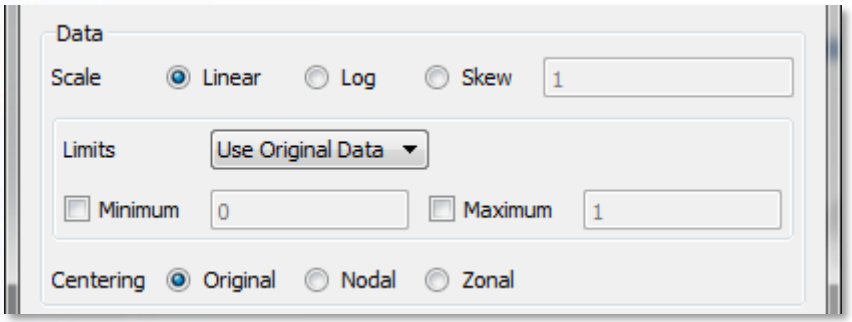

Skew scaling

Skew factor=5



# Limits

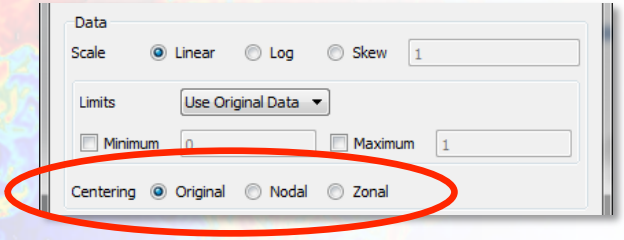
- Limits are the min and max values for a variable
- VisIt can use the limits for the original data or limits for the plot after any subsets have been removed
  - Original data limits are the limits of the variable when all subsets of the plot are considered
  - Current plot limits are the limits of the variable after subsets have been removed
  - You can independently set the min and max values for the plot's limits
- Set min and max values for movies to preserve color to value mapping



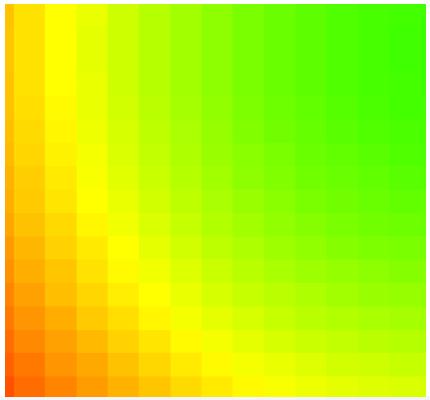
# Variable Centering

- Pseudocolor plot allows data to be displayed in its natural centering or in another centering
- Changing variable centering
  - Natural
  - Zonal
  - Nodal
- Node centered values cause the plot to look much smoother because VisIt draws the plot geometry with color interpolation

Centering controls




Zonal centering

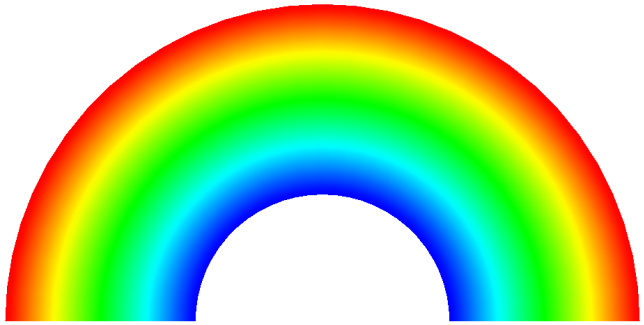


Nodal centering

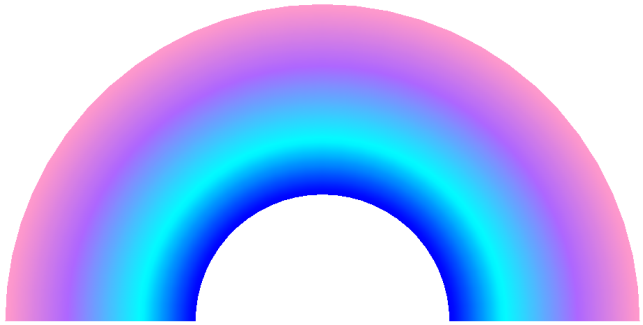
# Color Table

- The Pseudocolor plot uses a color table to color its data values
  - The color table can be the default continuous color table or a specific color table
  - Changing the color table changes the colors that the plot uses
  - The plot will update if the color table that it uses is modified

Pseudocolor with hot color table



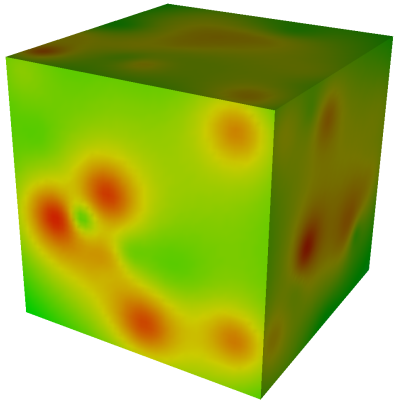
Pseudocolor with custom color table



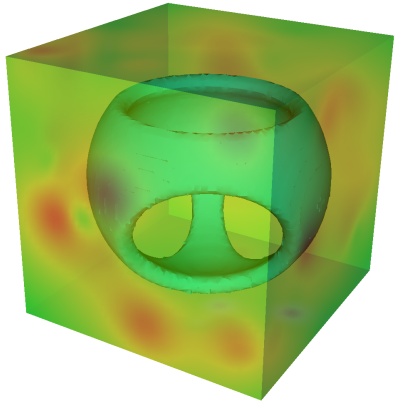
# Opacity

- The Pseudocolor plot can be made transparent by setting its opacity
  - Useful when other plots are in the same vis window but they are obscured by the Pseudocolor plot
  - Useful for fading in a plot during an animation
  - Opacity can be set explicitly or using color table

Fully opaque Pseudocolor plot obscures the other plot

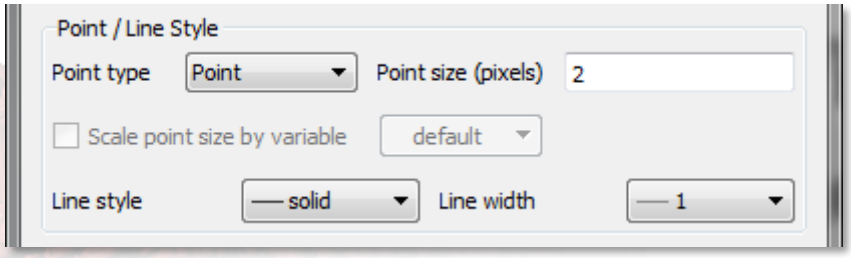


Partially transparent Pseudocolor plot reveals the other plot

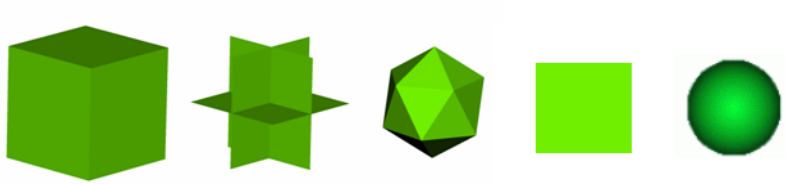


# Point / Line Style

Point type controls



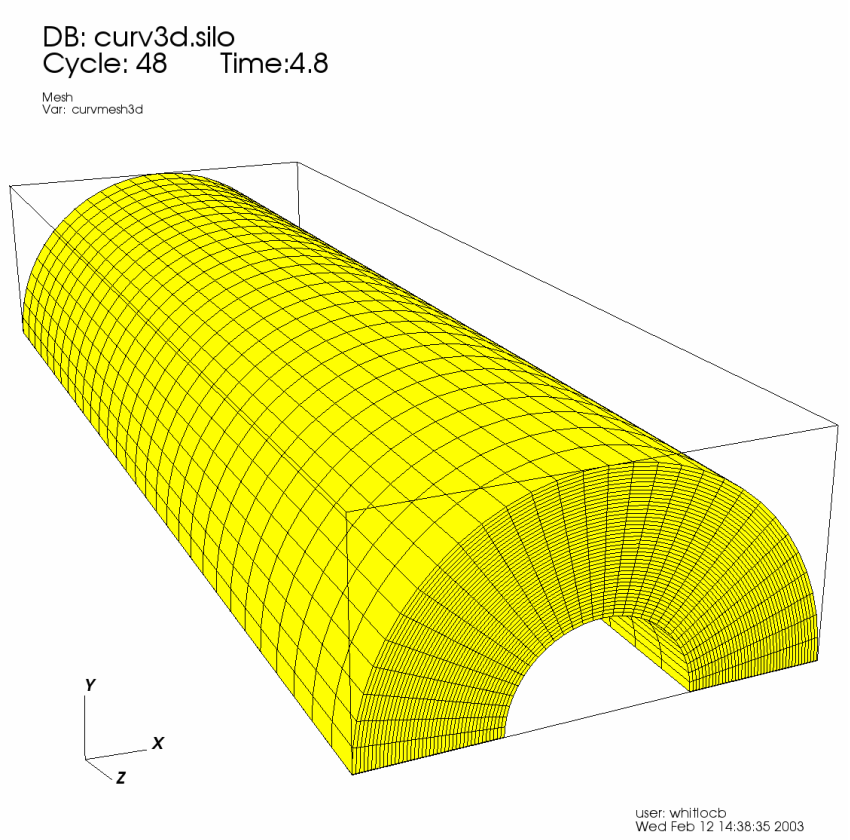

Point types



- Point types determine how the Pseudocolor plot displays variables defined on point meshes
- Point size determines how large the point is when drawn in the vis window
- Scale point size by variable allows VisIt to vary the point sizes per-point

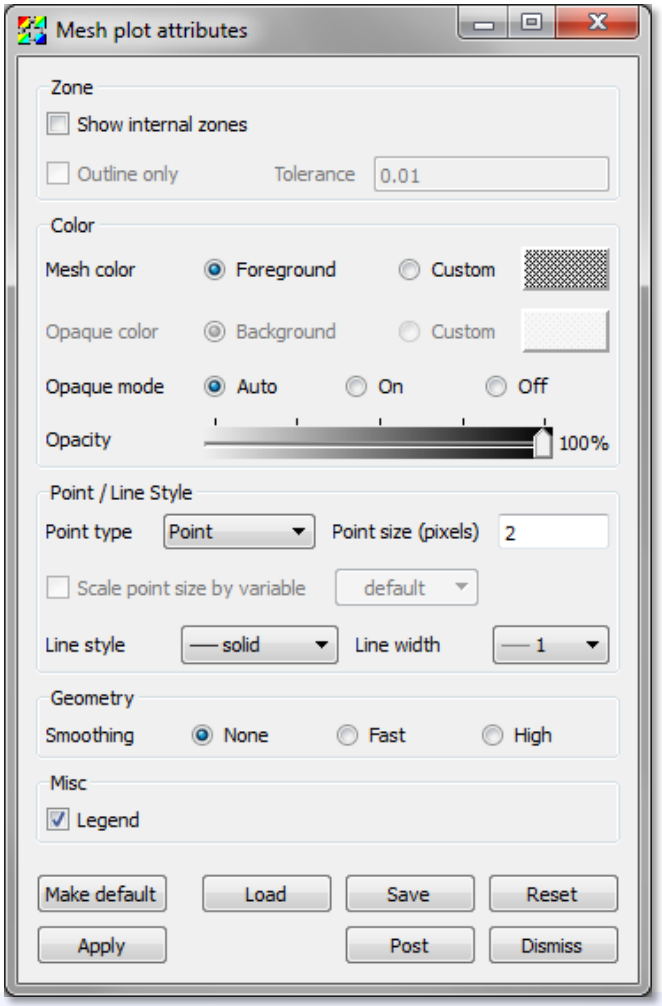
# Mesh Plot

- Use this plot when you want to see the layout of cells in the computational mesh
- Usually used with other plots
- This plot accepts meshes



# Mesh Plot Attributes

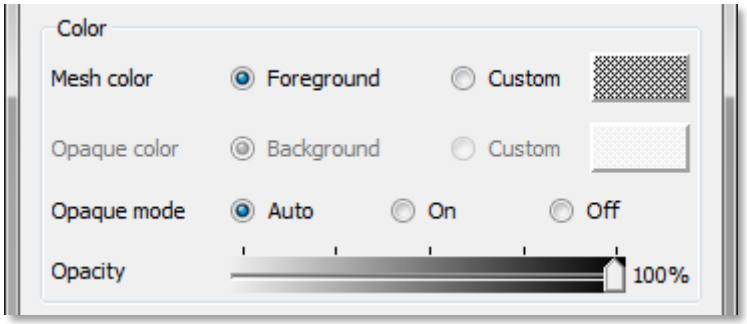
- Mesh color
- Opaque mode
- Mesh line properties
- Point / Line Style
  *(same as for Pseudocolor plot)*



# Mesh Color

- Mesh plots have two colors
  - Mesh color
    - Used for the lines that show the edges of cells
    - Can be the text color or a user-specified color
  - Opaque color
    - Used for the interior of cells
    - Only used when the plot is drawn opaquely
    - Can be the background color for the vis window or a user-specified color

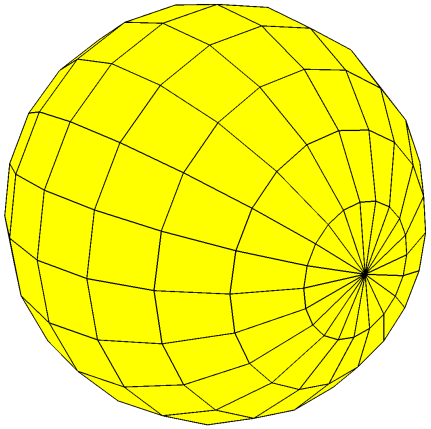
Mesh color controls



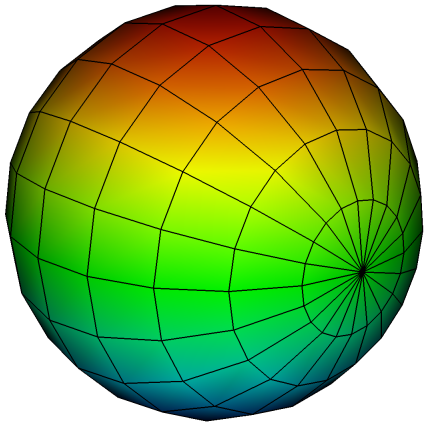
# Opaque Mode

- When the mesh plot is the only plot in the vis window cells are filled with the opaque color when VisIt draws them
  - This is opaque mode
- When other plots exist in the vis window, VisIt only draws the cell outlines so other plots still show through the Mesh plot
- By default, VisIt determines when to switch the Mesh plot in and out of opaque mode
  - You can override this behavior by telling VisIt when to draw the Mesh plot in opaque mode

Mesh plot drawn in opaque mode

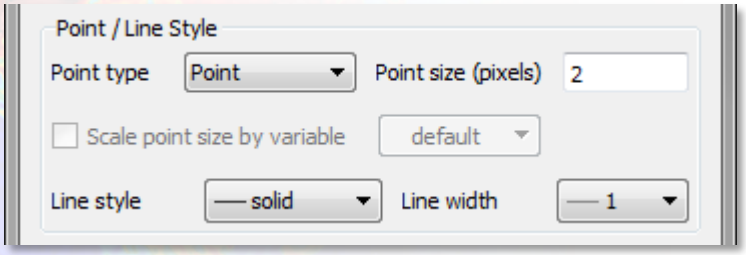


Mesh plot drawn with a Pseudocolor plot. Notice that the Pseudocolor plot shows through

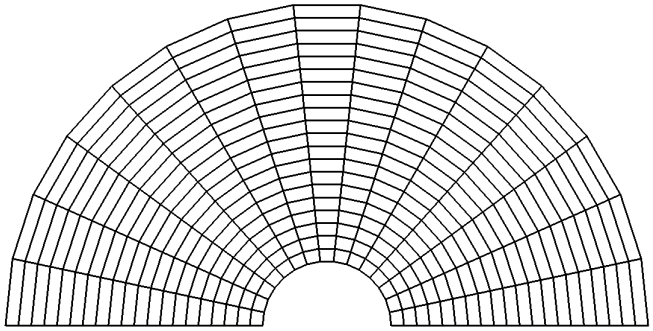


# Mesh Line Properties

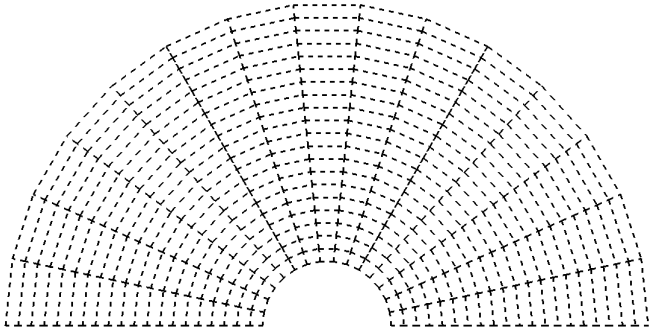
- Mesh line properties
  - Line style can be solid, dotted, dashed, or dot-dash
  - Line thickness can be from 1 to 8 pixels
- Mesh line properties apply to 2D and 3D meshes




Mesh plot with solid lines

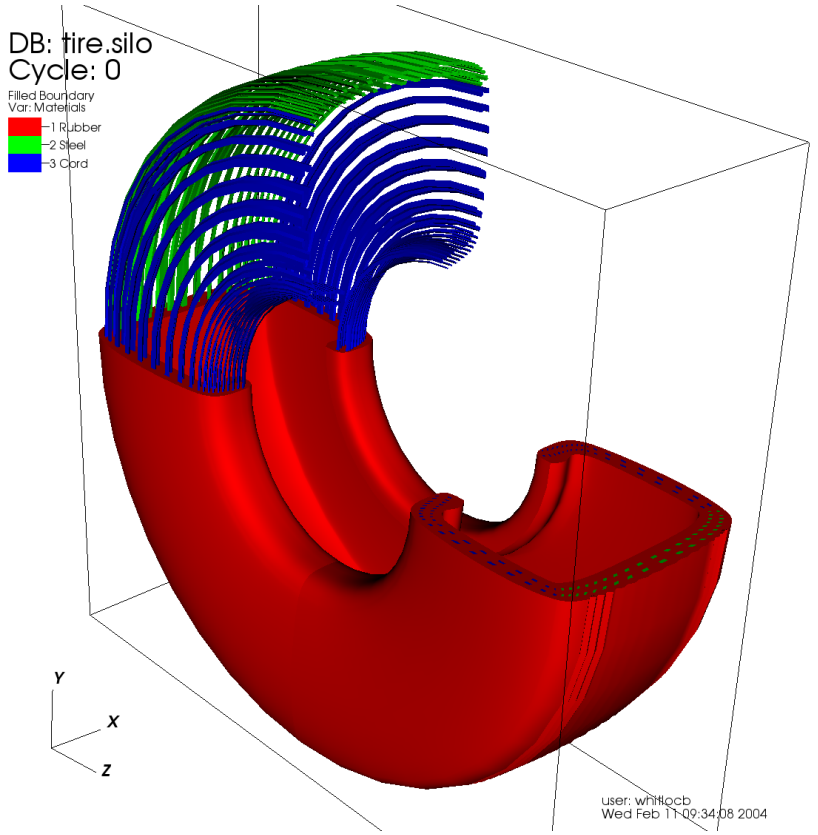


Mesh plot with dashed lines



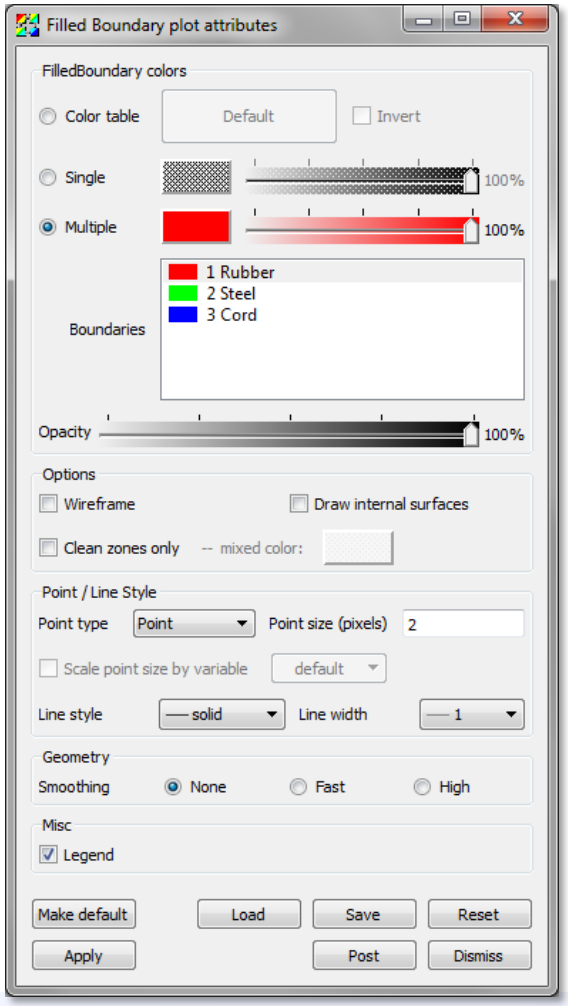
# FilledBoundary Plot

- This plot colors a plot's materials so it is obvious where they are located in the mesh
- Use this plot when you want to plot materials



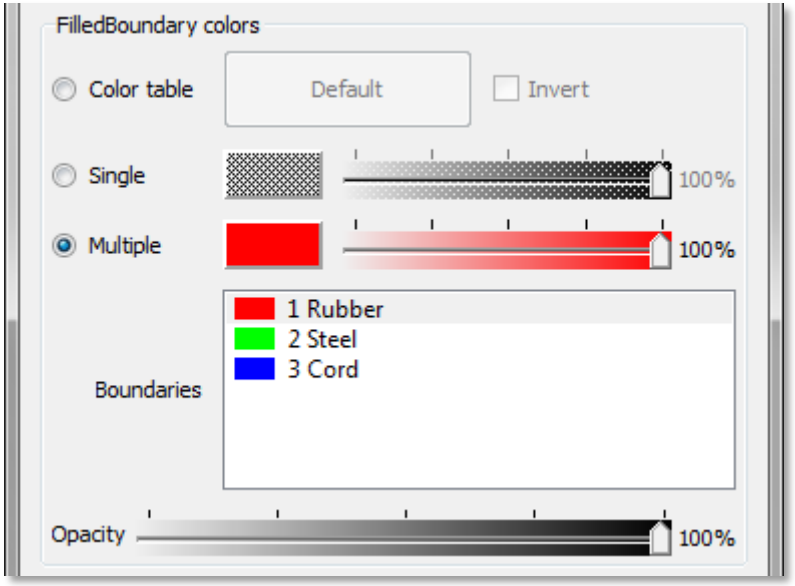
# FilledBoundary Plot Attributes

- Filled boundary colors
- Opacity and internal surfaces
- Clean zones only



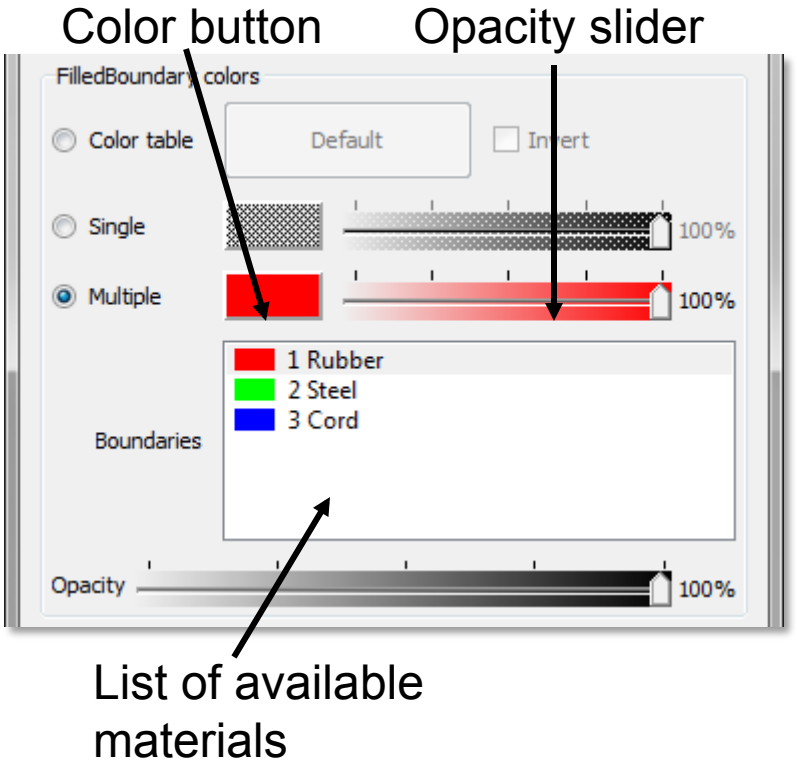
# Picking Colors

- Three color modes
  - Color table
  - Single
  - Multiple
- Color table mode uses the specified color table for the subsets
  - The active discrete color table is used by default but any color table can be used
  - Each subset gets a unique color when using a continuous color table
- Single color mode colors all subsets the same color and same opacity
- Multiple color mode lets you pick a color and opacity for each subset

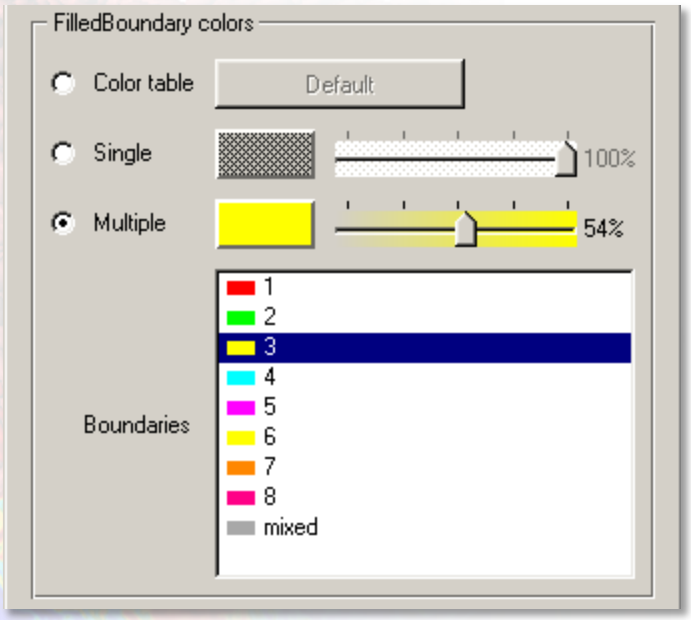


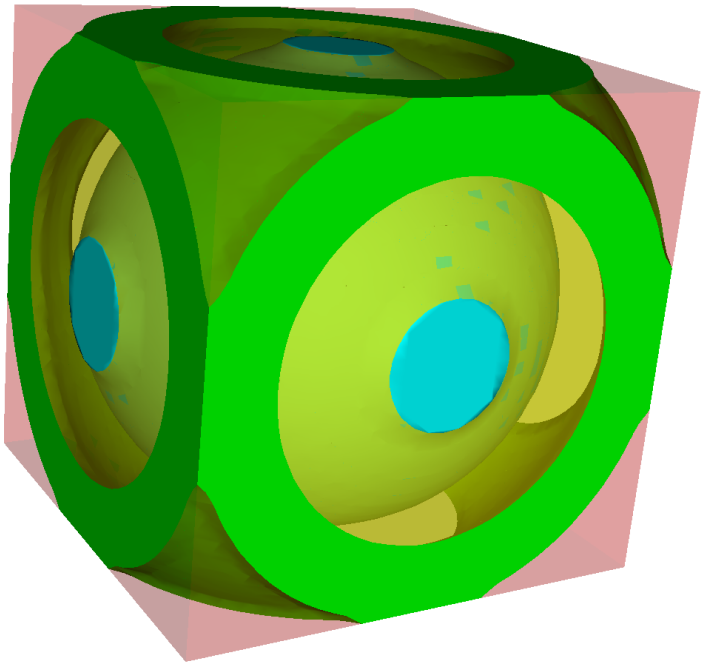
# Picking Colors in Multiple Mode

- Each material can have its own color and opacity
- To pick colors for materials when using multiple color mode
  - Click on a material in the list
  - You can select multiple materials if you want them to get the same color or opacity
  - Click on the color button and pick a new color from the color palette
  - Change the opacity by using the opacity slider next to the color button

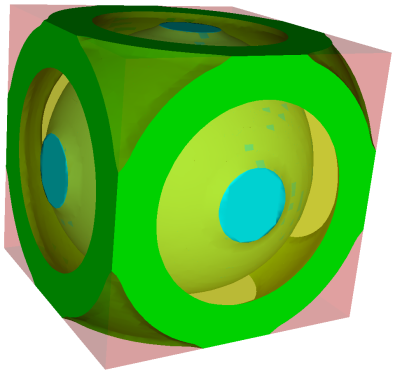


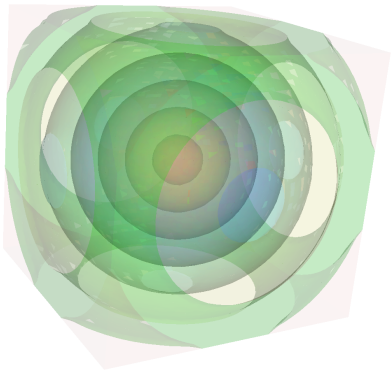
# Picking colors in multiple mode



# Opacity and Internal Surfaces



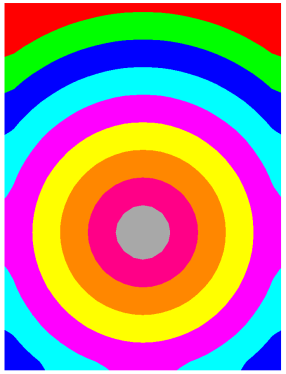


- When the FilledBoundary plot displays a material, the opacity used for the subset is multiplied by the plot's global opacity so the relative opacities for different materials are preserved
- Opacity is most useful if you tell VisIt to draw the internal surfaces, which are the material boundaries that fall within the mesh and would not normally be seen in 3D

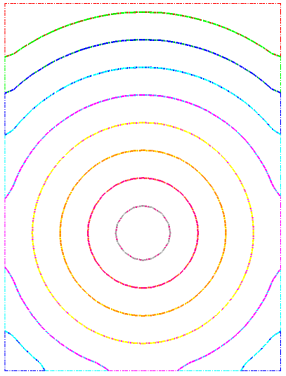
# Boundary Line Properties

- Boundary line properties
  - Line style can be solid, dotted, dashed, or dot-dash
  - Line thickness can be from 1 to 8 pixels
- Boundary line properties apply only when the plot is displayed in Wireframe mode
- Wireframe mode
  - Shows only the feature edges of the boundaries between subsets

FilledBoundary plot when not in wireframe mode



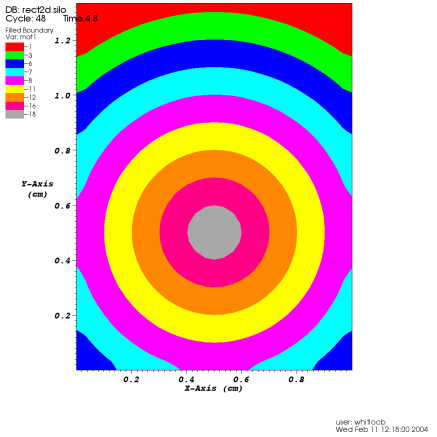
FilledBoundary plot in wireframe mode



# Plotting Clean Zones Only

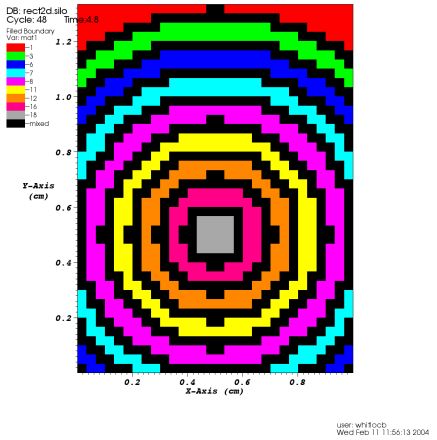
- VisIt reconstructs material boundaries
- Sometimes it is useful to see only cells that have a single material
- The FilledBoundary plot provides a Clean zones only option so mixed cells are drawn all in the same color, which you can set in multiple color mode
- Mixed cells are usually drawn in the background color so it looks like only clean cells are drawn

All cells are plotted and interfaces in mixed cells have been computed



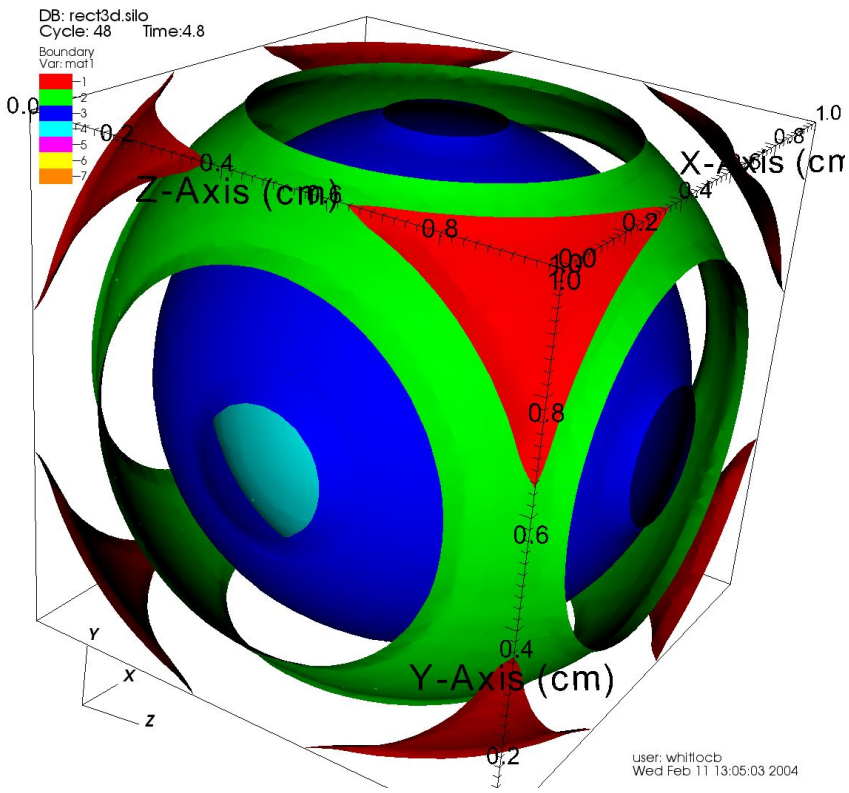

Clean zones only

*(mixed cells are black)*



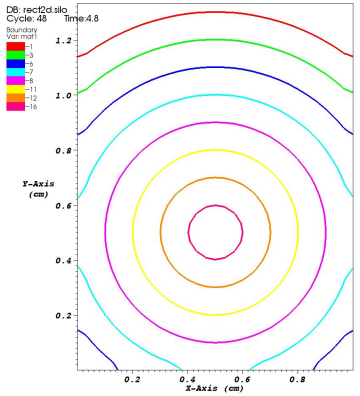
# Boundary Plot

- This plot shows the boundaries between materials
- Use this plot when you want to see the boundaries between materials

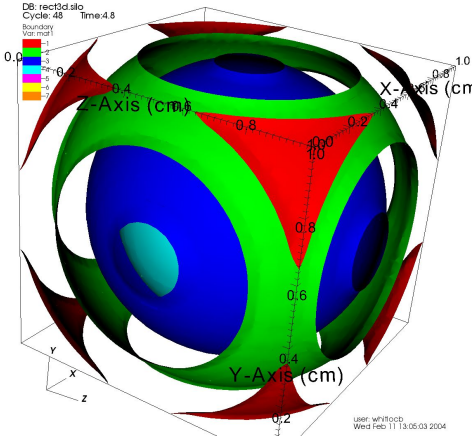


# Boundary Plot Shows Material Boundaries

Boundaries of 2D objects are 1D lines in 2D space



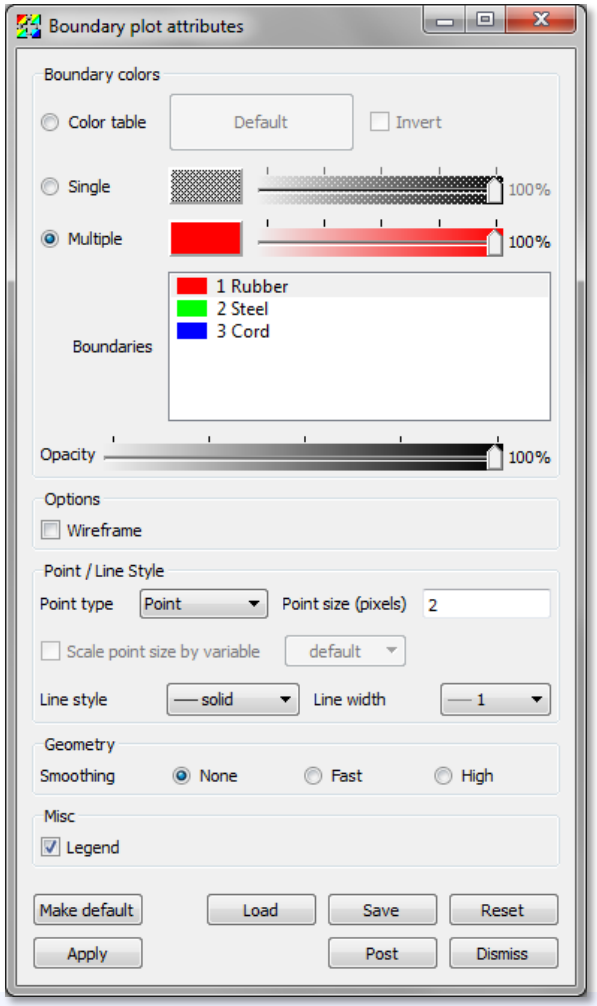

Boundaries of 3D objects are 2D surfaces in 3D space




- VisIt performs material interface reconstruction when the Boundary plot shows materials

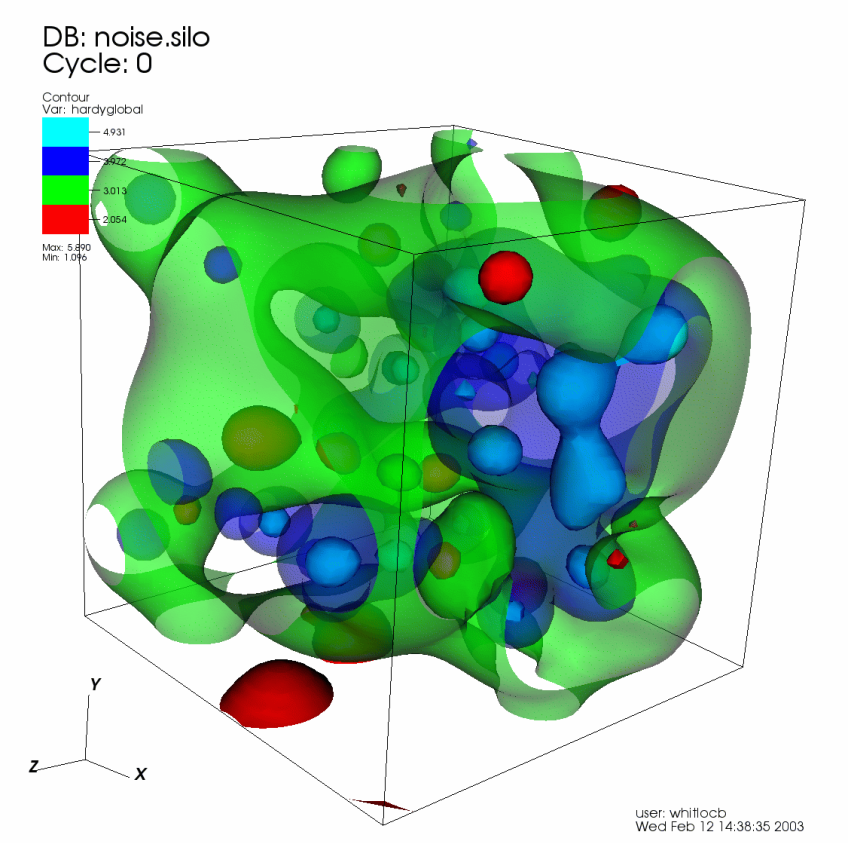
# Boundary Plot Attributes

- Boundary plot attributes are nearly identical to the attributes for the FilledBoundary plot
  - Boundary line properties
  - Boundary colors
  - Opacity



# Contour Plot

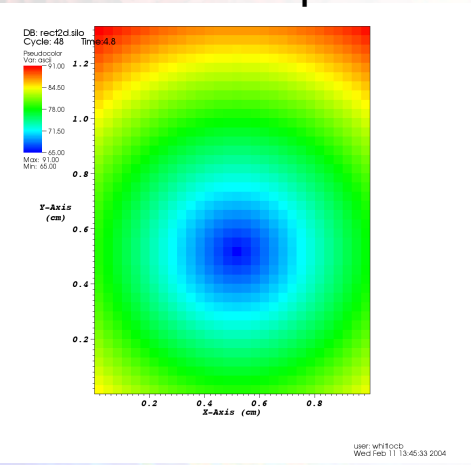
- This plot traces out lines or surfaces of constant value through a scalar field and colors each contour with its own color
- Use this plot when you want to divide the range of a scalar variable into bins that you can see
- This plot accepts scalar variables



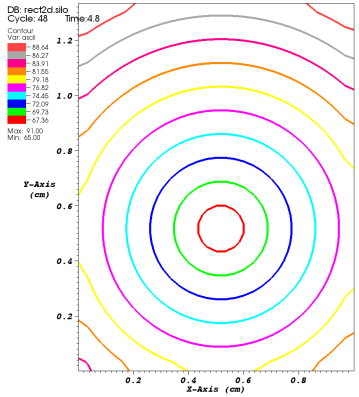
# Contour Plot

- A contour plot is often used with a Pseudocolor plot to show scalar field behavior
- The contour plot divides the data range into bins that help to interpret the Pseudocolor plot

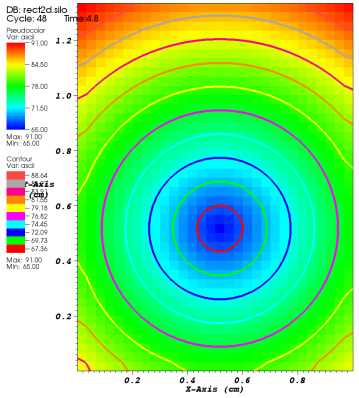
Pseudocolor plot




Contour plot

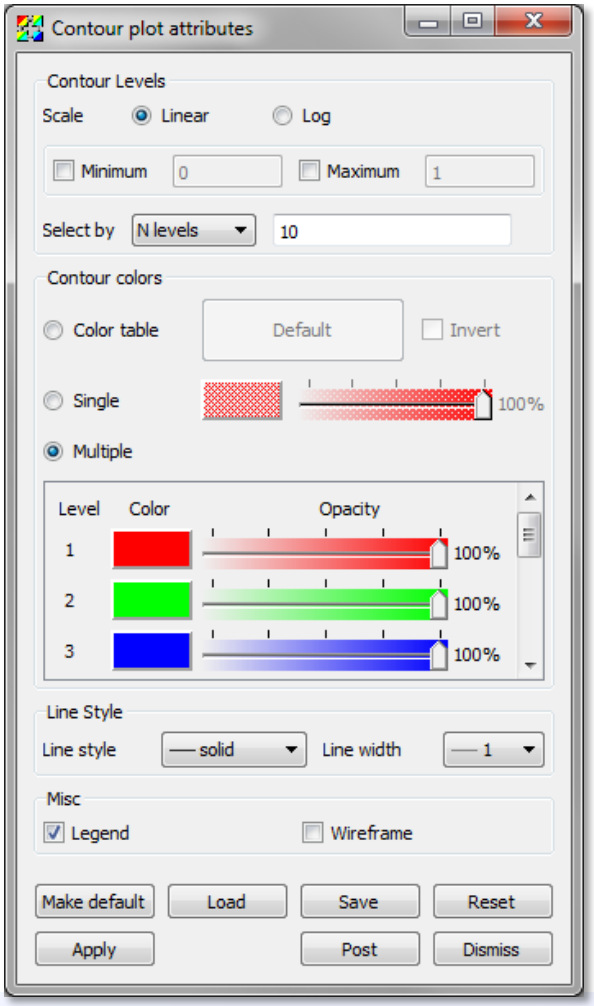



Both plots



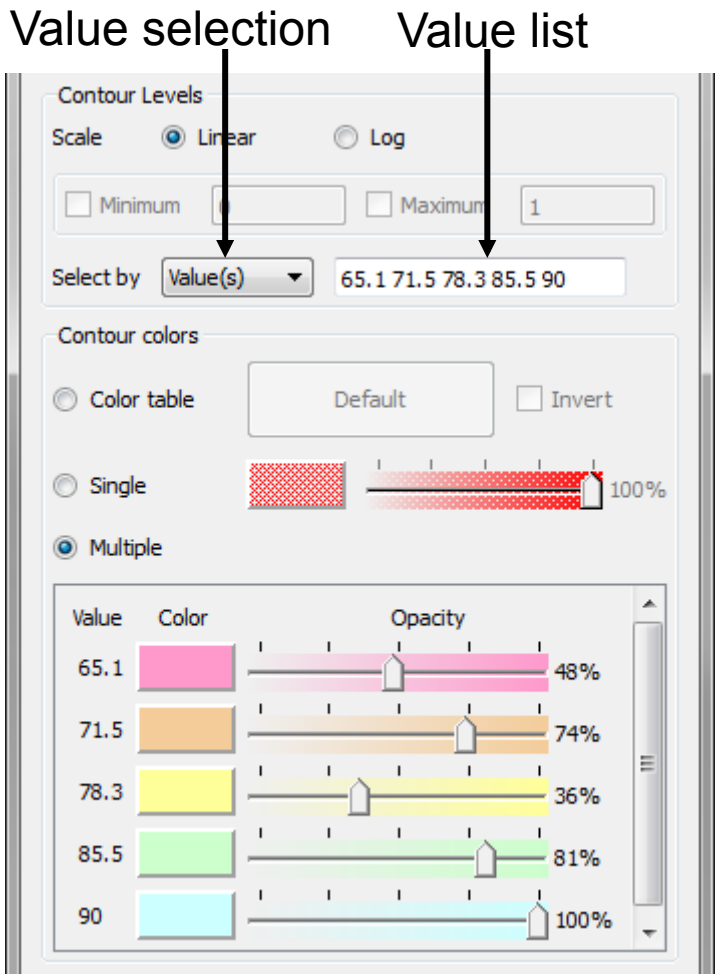
# Contour Plot Attributes

- Contour selection
- Contour colors



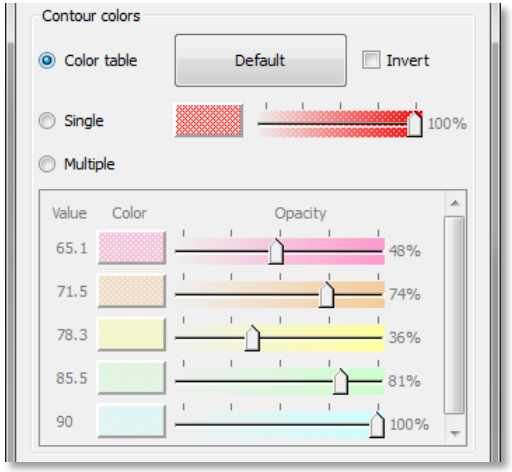
# Contour Selection

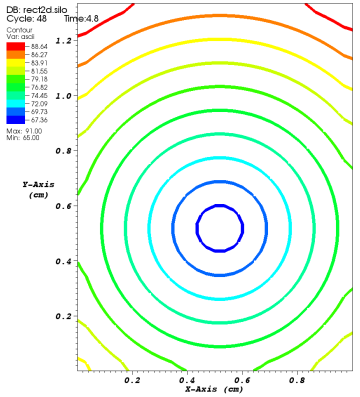
- There are three ways to specify the contours
  - N levels
  - Percent
  - Value
- N levels picks N equally spaced values from the data range and creates contours for those values
- When using percent selection, you provide a list of percentages, which are used to determine contour values from the data range
- When using value selection, you provide a list of values that will be used for contours
- The number of contours in the contour list adjusts



# Picking Contour Colors

- Three color modes
  - Multiple
  - Single
  - Color table
- Multiple color mode lets you pick a color and opacity for each contour
- Single color mode colors all contours the same color and same opacity
- Color table mode uses the specified color table for the contours
  - The active discrete color table is used by default but any color table can be used
  - Each contour gets a unique color when using a continuous color table
  - Increasing the number of contours redistributes the color table among the new list of contours

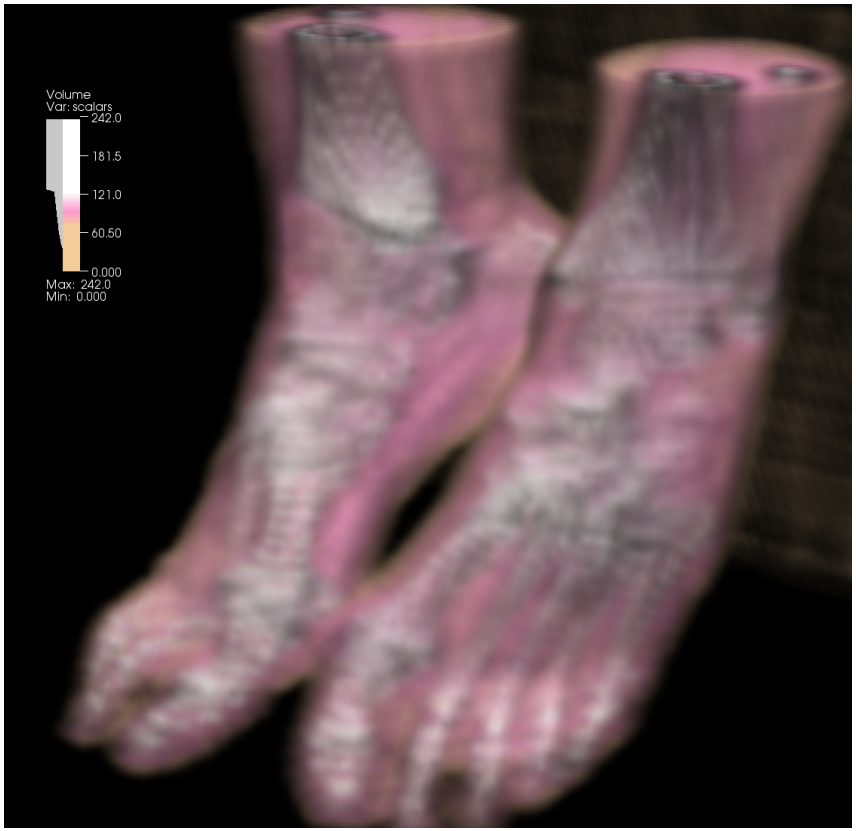


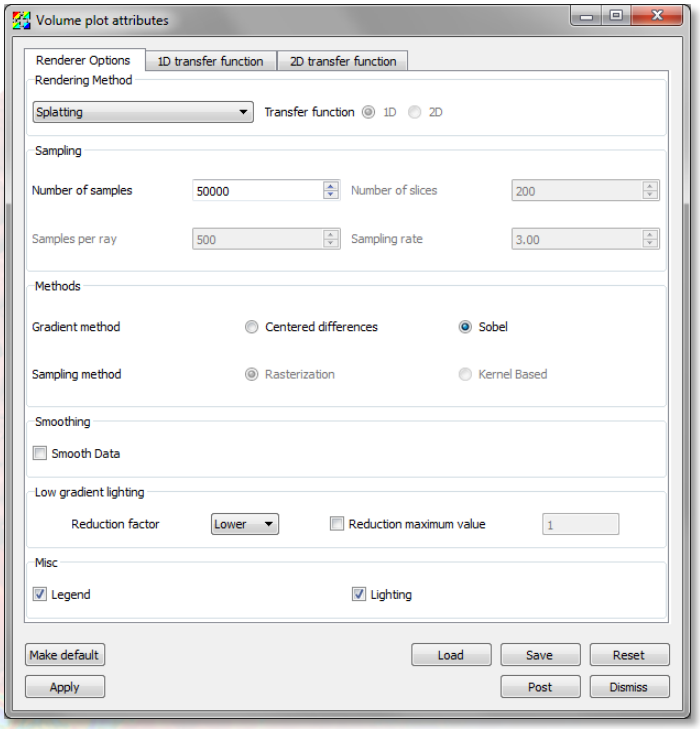

Color table mode

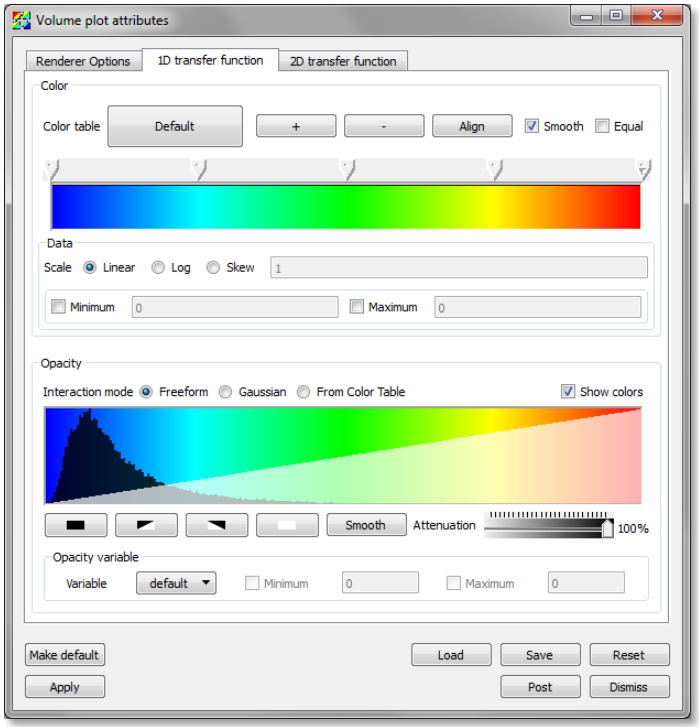
# Volume Plot

- This plot uses both color and transparency to visualize 3D scalar variables
- Use this plot when you want to look at internal features of a scalar variable while keeping all of the plot at least partially visible
- This plot accepts 3D scalar variables



# Volume Plot Attributes




- Rendering Options
- 1D transfer function

# Rendering Method

- Volume plot has 5 rendering methods
  - Splatting renderer
    - Less accurate
    - Hardware accelerated and moderately fast
    - 10's of frames per second
  - 3D texturing renderer
    - More accurate than splatting
    - Hardware accelerated and very fast
    - 10's to 100's of frames per second
  - Software raycasting renderer
    - Best quality image
    - Memory intensive
    - Seconds per frame
    - Parallelized
    - Can handle largest data sizes
  - Software raycasting integration
  - SLIVR (hardware shader)

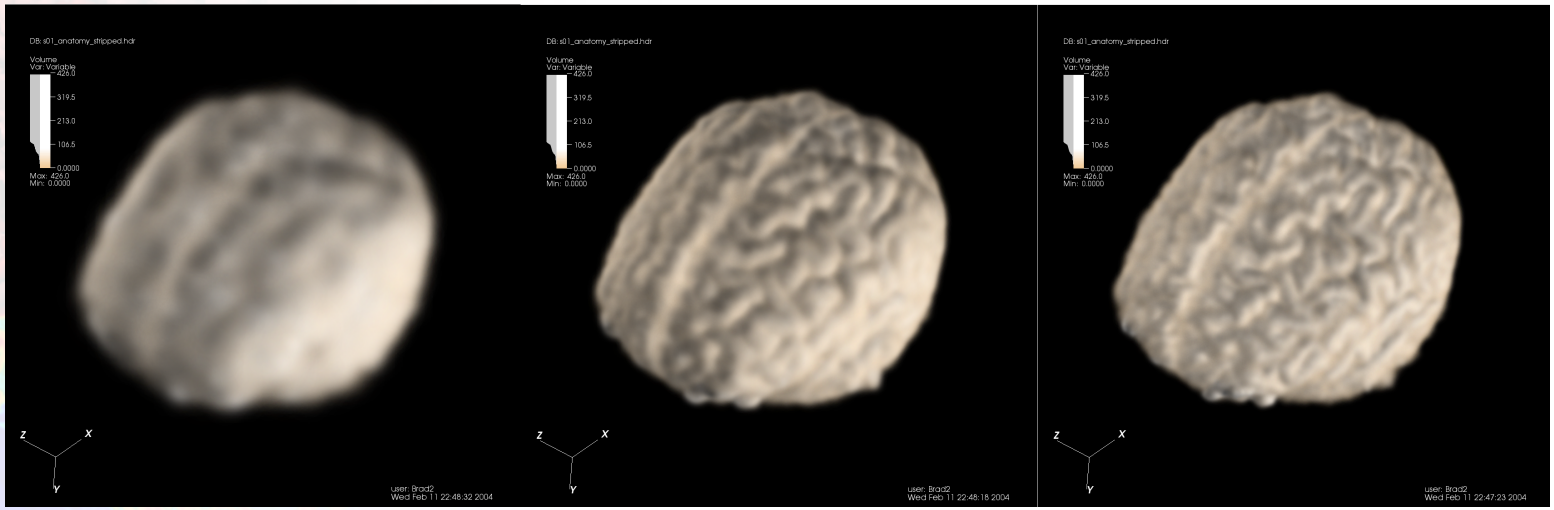
# Number of Samples

Brain dataset with 8,000,000 cells

50,000 sample points

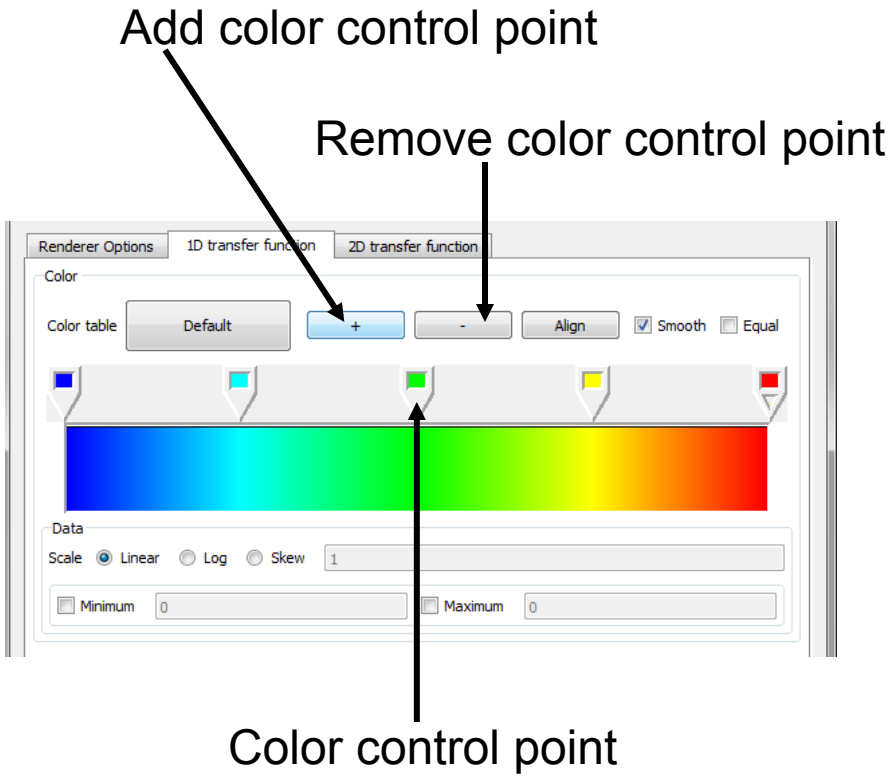
500,000 sample points

1,500,000 sample points



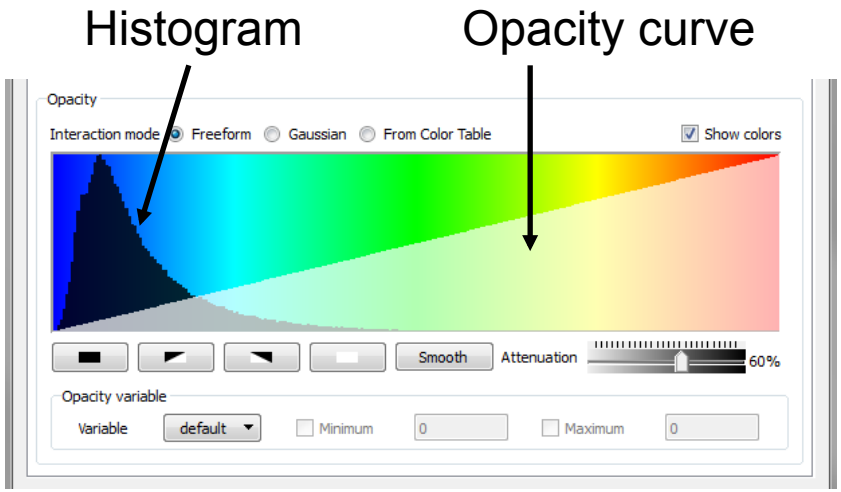
# Changing Colors

- Like the Pseudocolor plot, the Volume plot maps the data range to a set of colors
- Volume plot colors are changed by editing color control points
- Change color for a control point by right clicking on it and selecting from the color palette
- Move a color control point by clicking the mouse on it and dragging it to a new location
- Add or remove color control points with “+” or “-” buttons



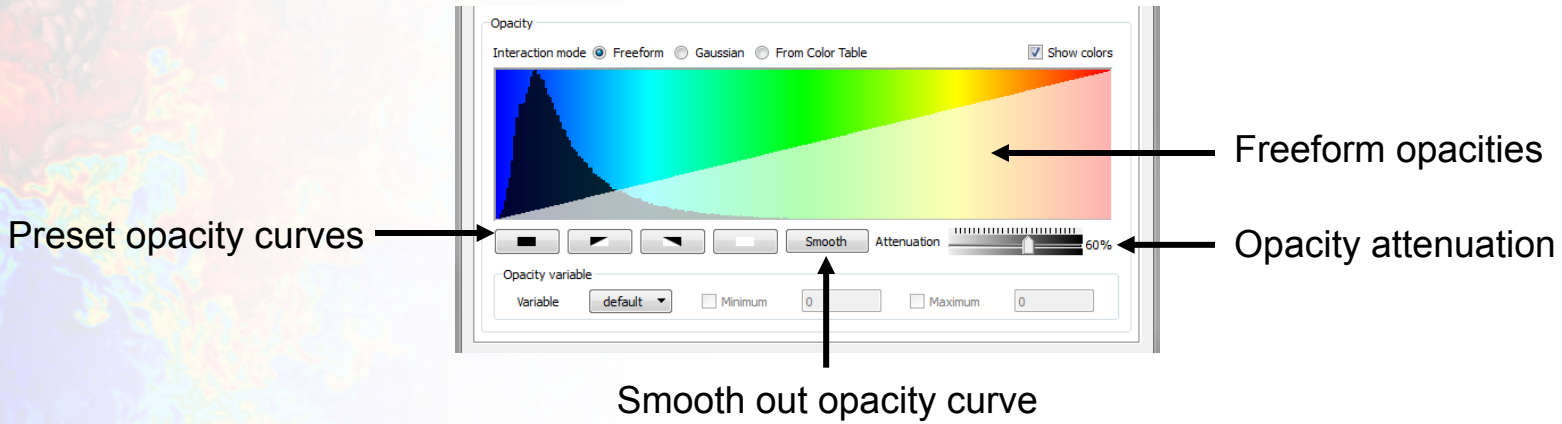
# Opacity

- Opacity determines which data values in the Volume plot can be seen
  - Opacity is defined for each value in the data range
  - Data values with small opacity are more transparent or even invisible
- Opacity can be set two ways
  - Freeform controls
  - Gaussian controls
- Attenuation factor is multiplied by all opacities to help decrease all opacities at once
- Opacity variable can be given so color can come from one variable and opacity another



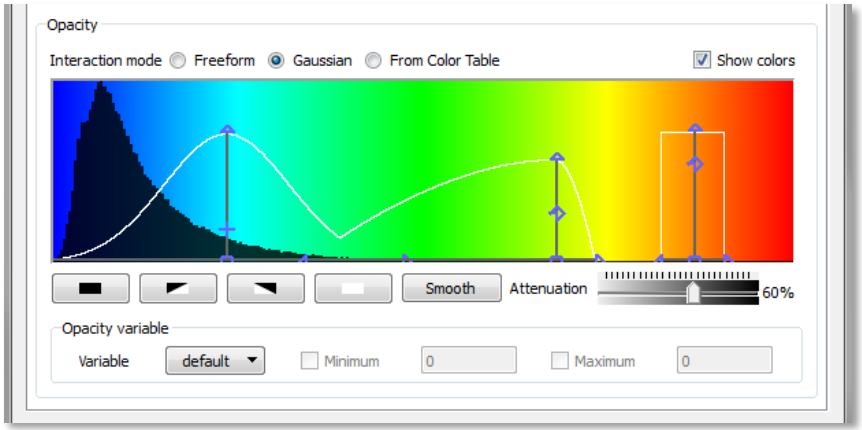
# Freeform Opacity

- Draw the shape of the opacity curve and smooth it with the smooth button
- Clear the opacities, make them all fully opaque, or make a linear ramp

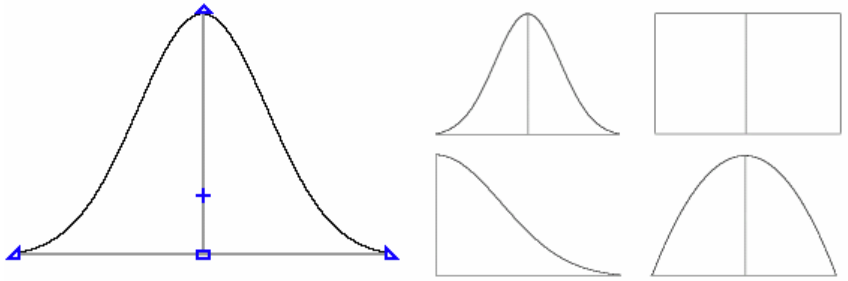


# Gaussian Opacity Controls

- Design opacity curve using a few opacity curves that can be modified by moving their control points
- Add a new curve by clicking in the curve area
- Remove a curve by right clicking on one of its control points

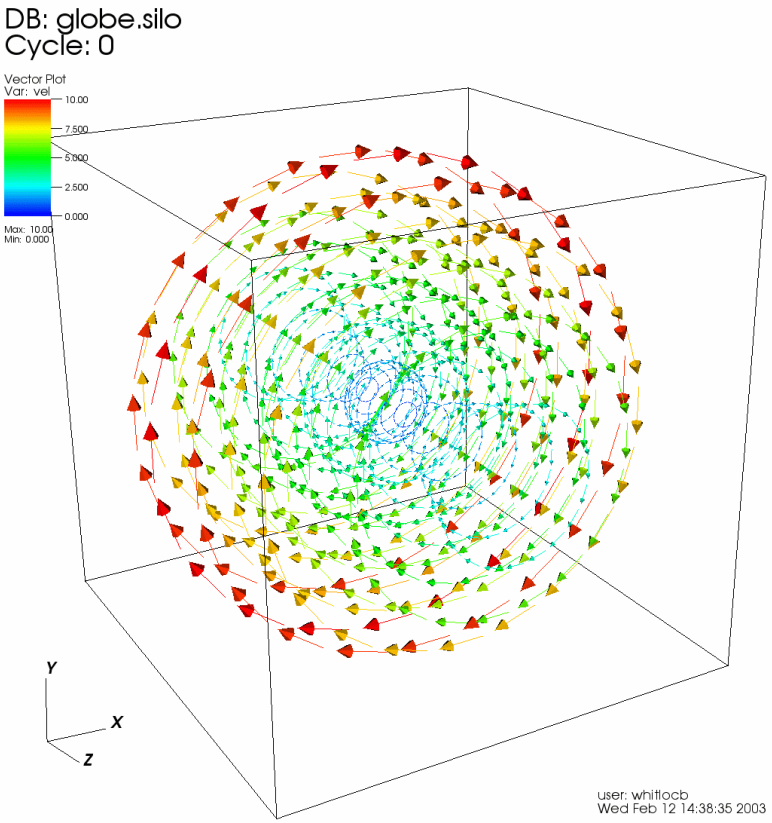



Gaussian curve shapes



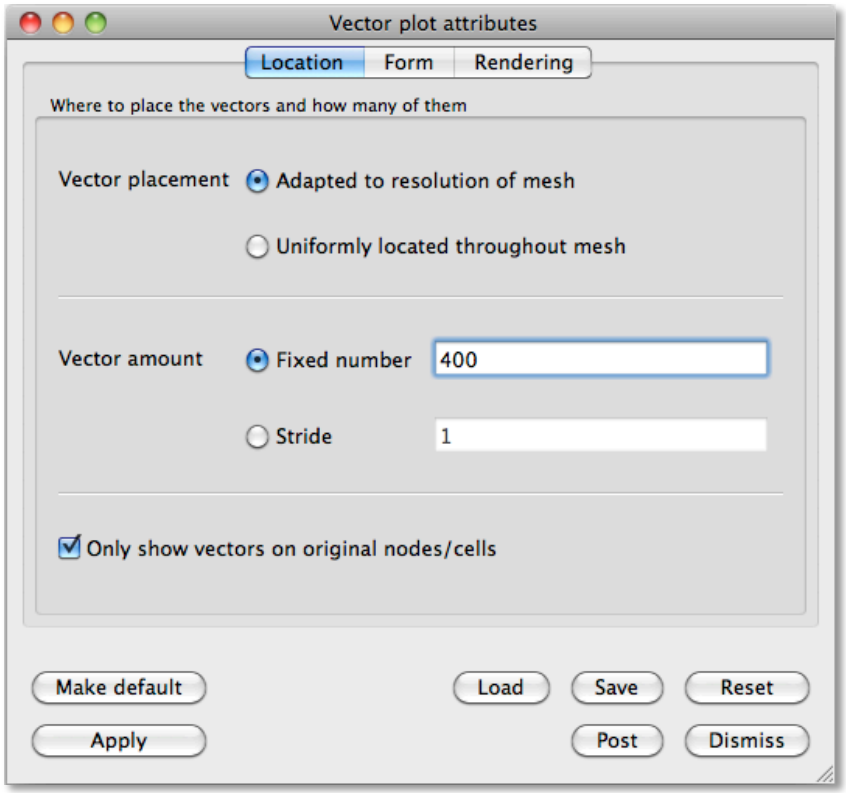
# Vector Plot

- This plot creates vector glyphs so you can see the general behavior of a vector field
- Use this plot when you want to investigate the behavior of a vector variable
- This plot accepts vector variables



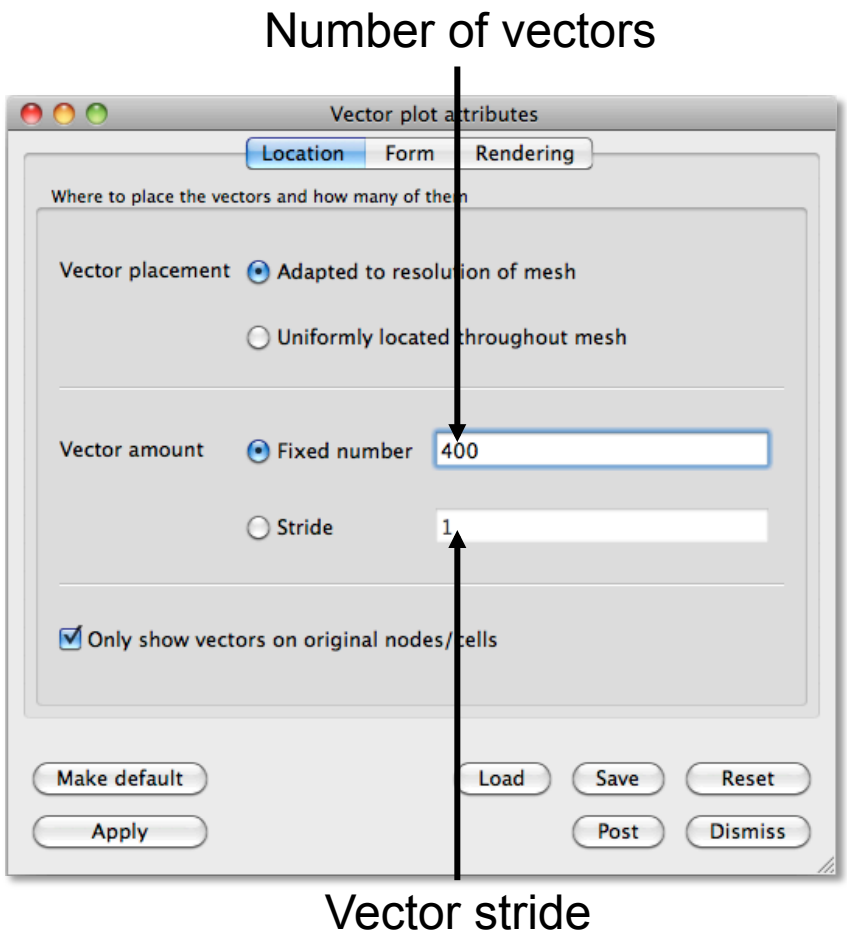
# Vector Plot Attributes

- Location
- Form
- Rendering

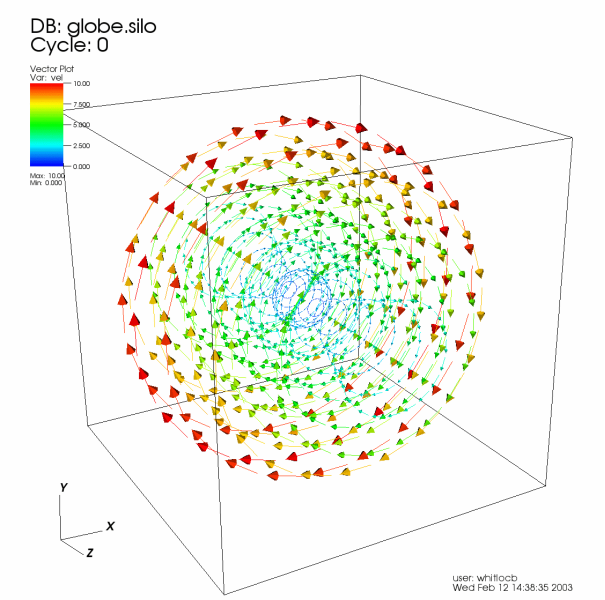


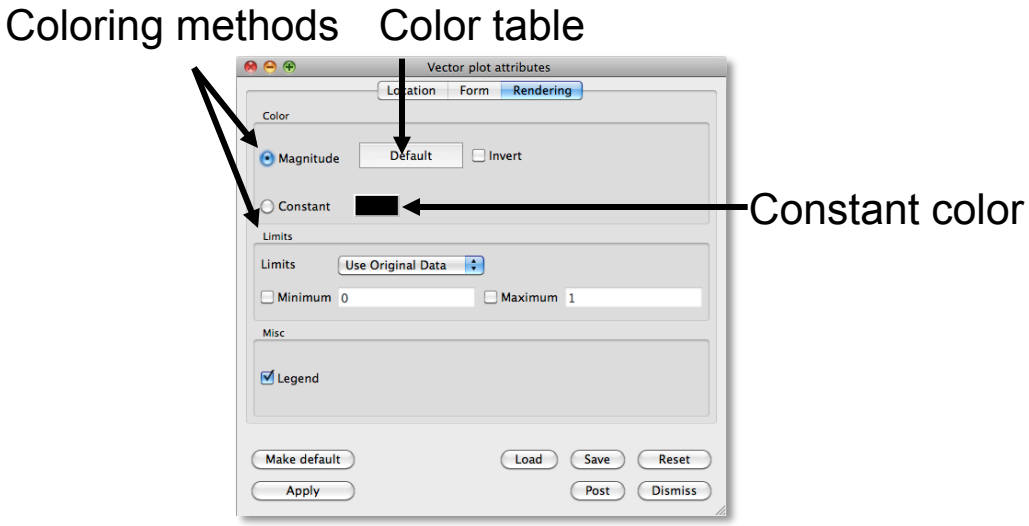
# Number of Vectors

- Vector plot displays a few hundred vector glyphs by default
  - Often enough to get a rough idea of the vector field's behavior
- Sometimes the default number of vectors is not enough to discern the behavior of the field
- Set number of vectors by
  - Setting a maximum number of glyphs
  - Setting a stride



# Vector Color

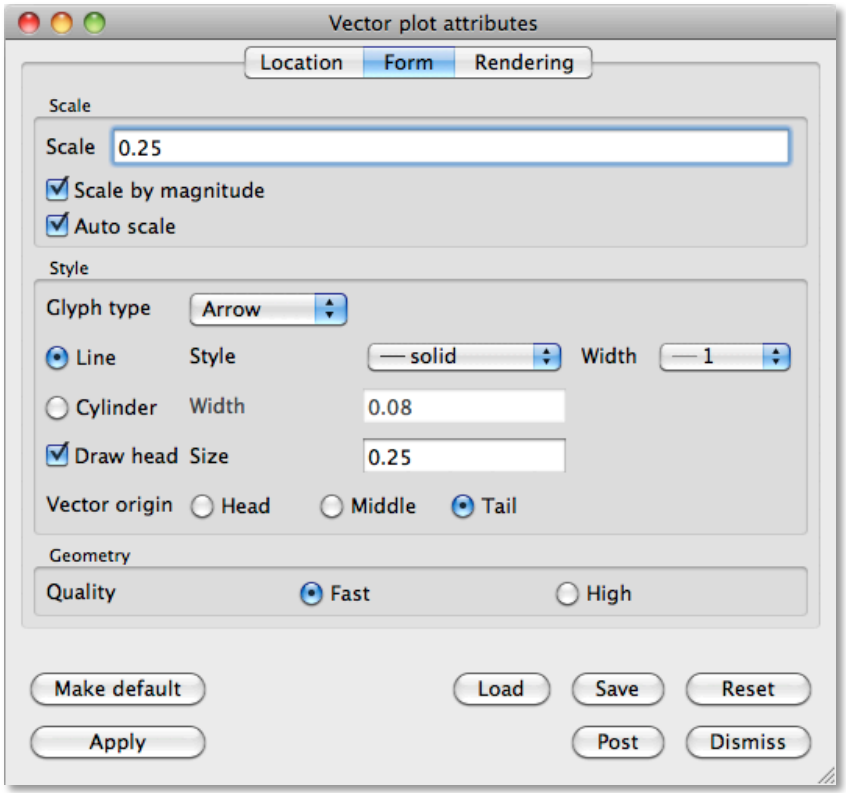



- Vectors can be colored by their magnitudes using a color table
- Vectors can all be the same color

# Vector Scale

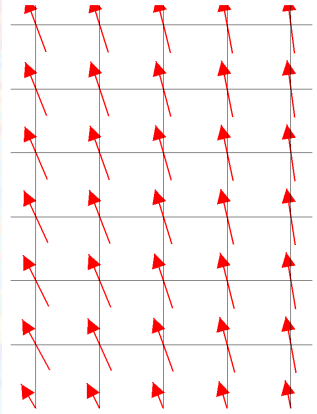
- Vectors are scaled relative to their magnitudes or automatically scaled against dataset size
- Head and tail can be scaled independently
- Scale is specified as a percentage of the vector's magnitude
- Head size is specified as a percentage of the vector's length as it is drawn



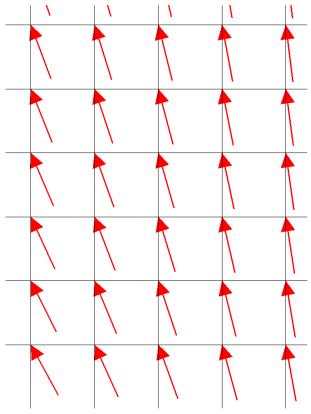
# Vector Origin

- The origin of the vector glyph can be located at the head, middle, or tail of the vector

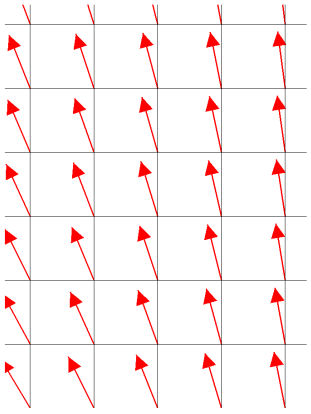
Origin at middle



Origin at head

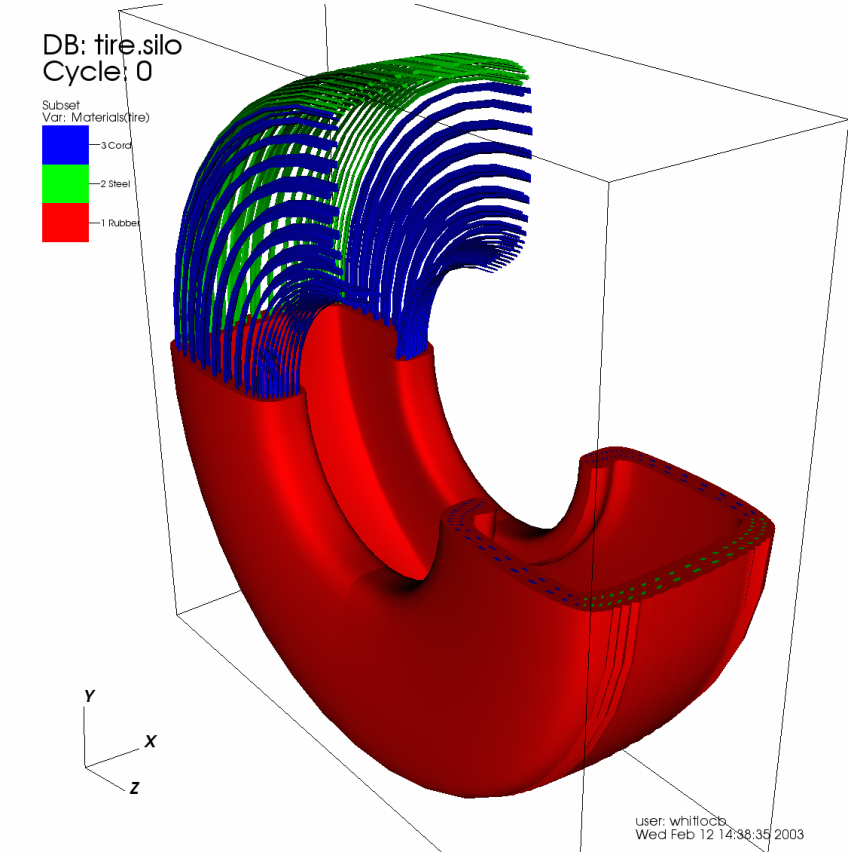


Origin at tail



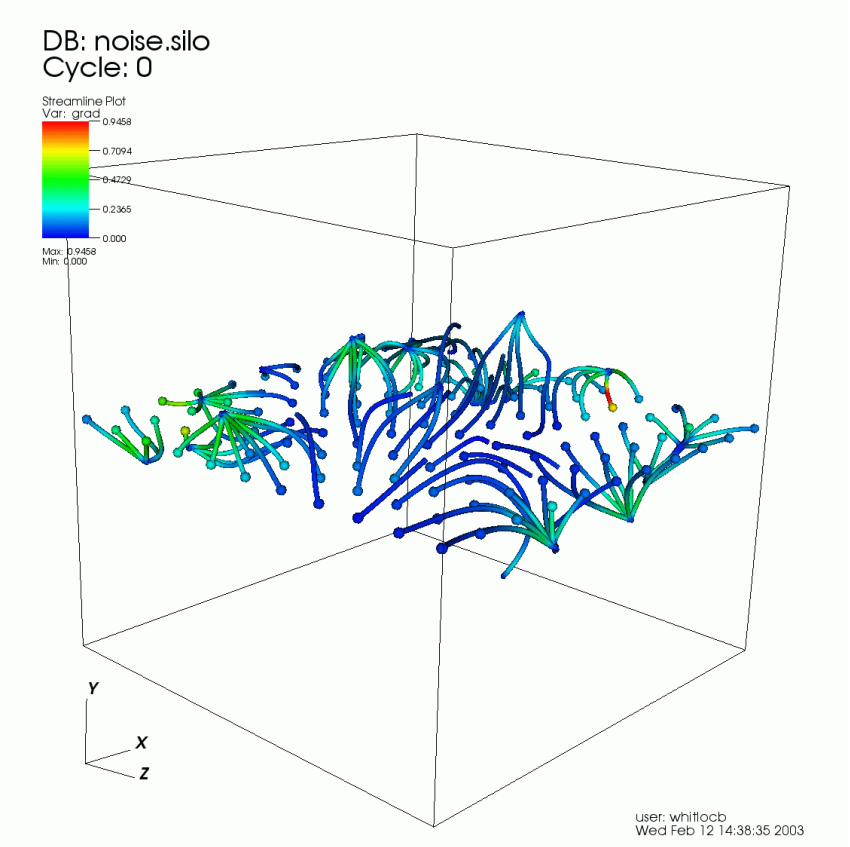
# Subset Plot

- Nearly identical to FilledBoundary plot
- FilledBoundary plot actually came from the Subset plot
- Subset plot does not handle materials specially like FilledBoundary does in some cases so it is more general and applies to any subset category including:
  - Materials
  - Domains
  - Groups
  - AMR Patches
  - AMR Levels



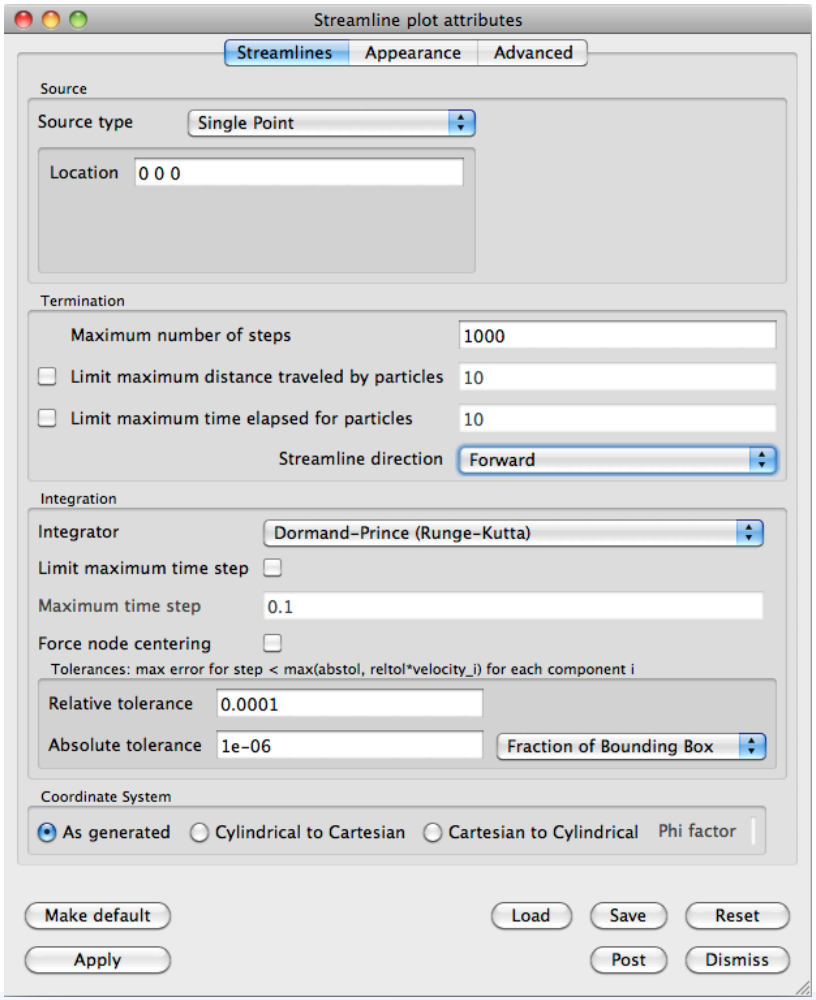
# Streamline Plot

- This plot integrates a path through a vector field using a set of seed points
- The resulting path is that which a small particle might take when traveling through the vector field
- Use this plot when you want to investigate the behavior of a vector variable
- *Integrates across domain boundaries*
- *Integrates across AMR levels*
- *Works well in parallel*
- *Pathlines are also supported*

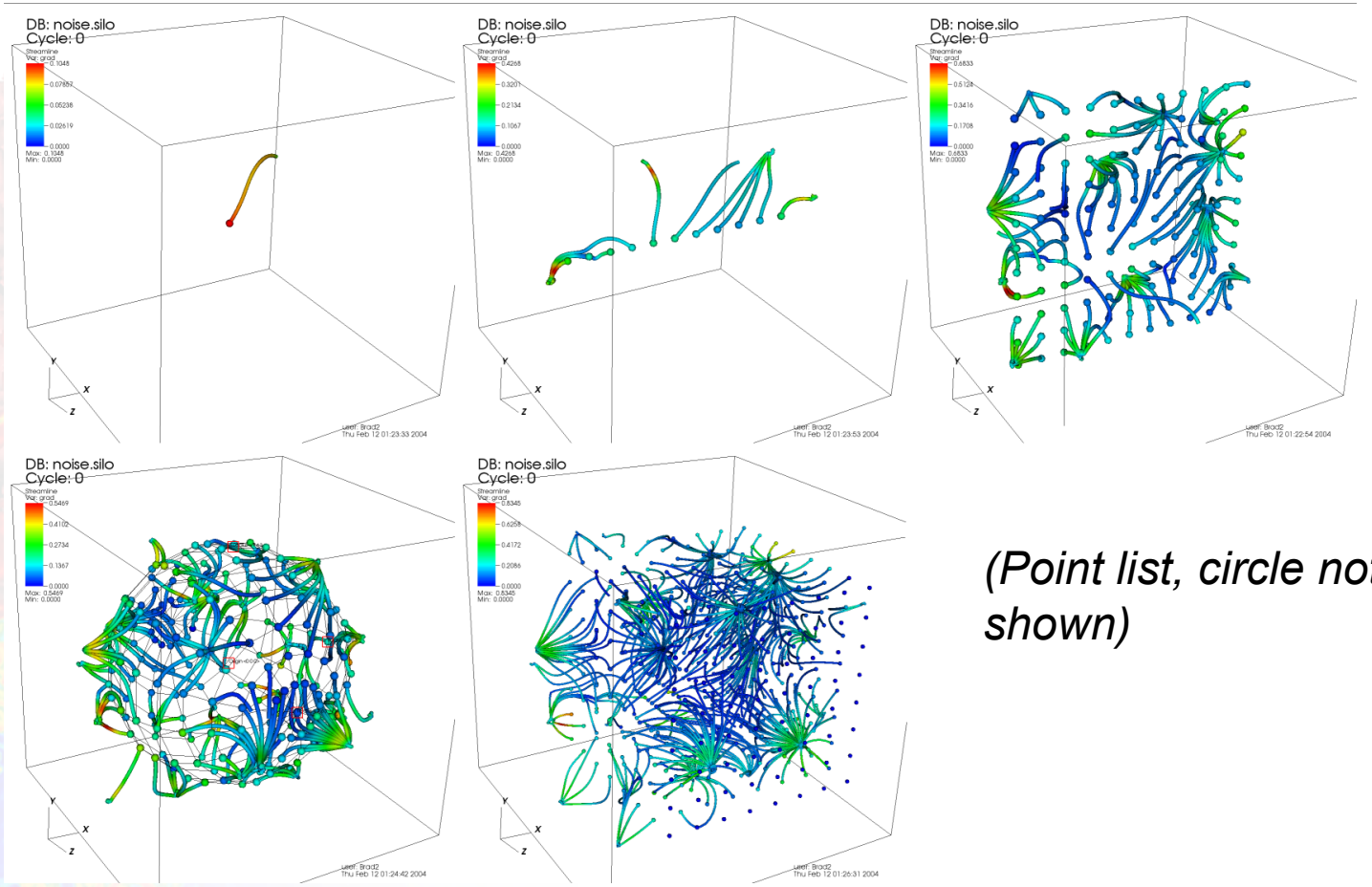


# Streamline Controls

- Sources
  - Control how streamline seed points are created
- Termination criteria
  - Controls integration distance
- Integration
  - Set options for solvers



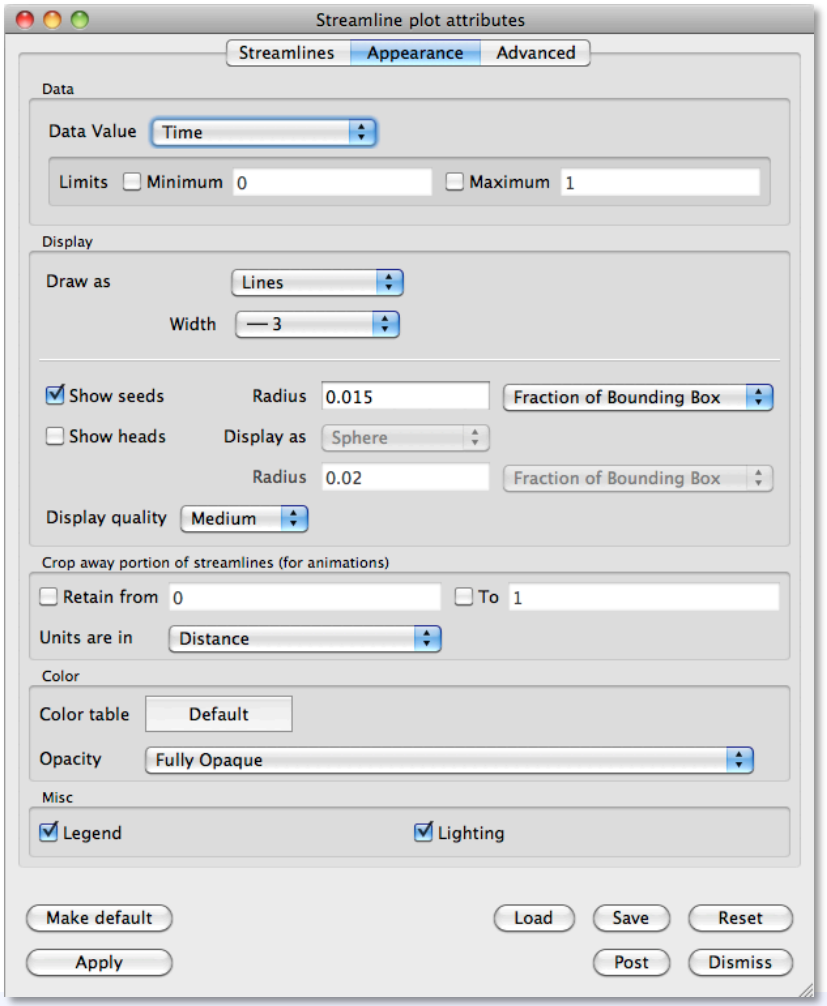
# Streamline Sources




*(Point list, circle not shown)*

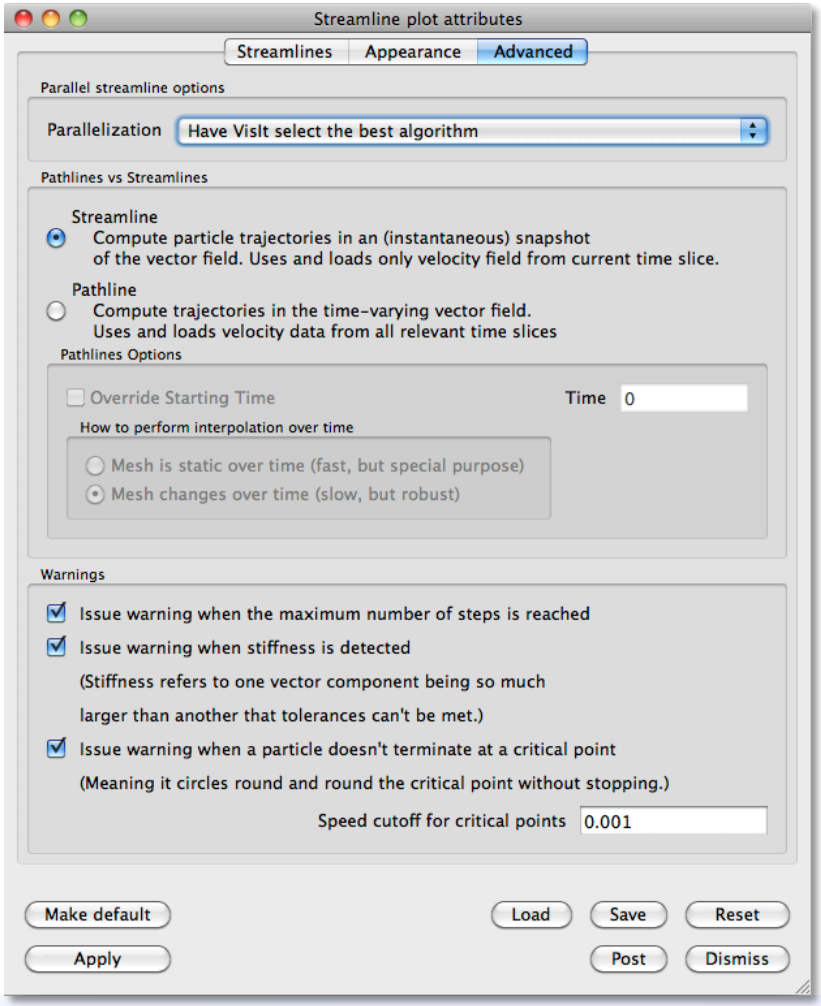
# Streamline Appearance

- Color by streamline variables or solid color
- Vary streamline opacity
- Draw as lines or tubes
- Show seed points
- Crop streamlines for animation



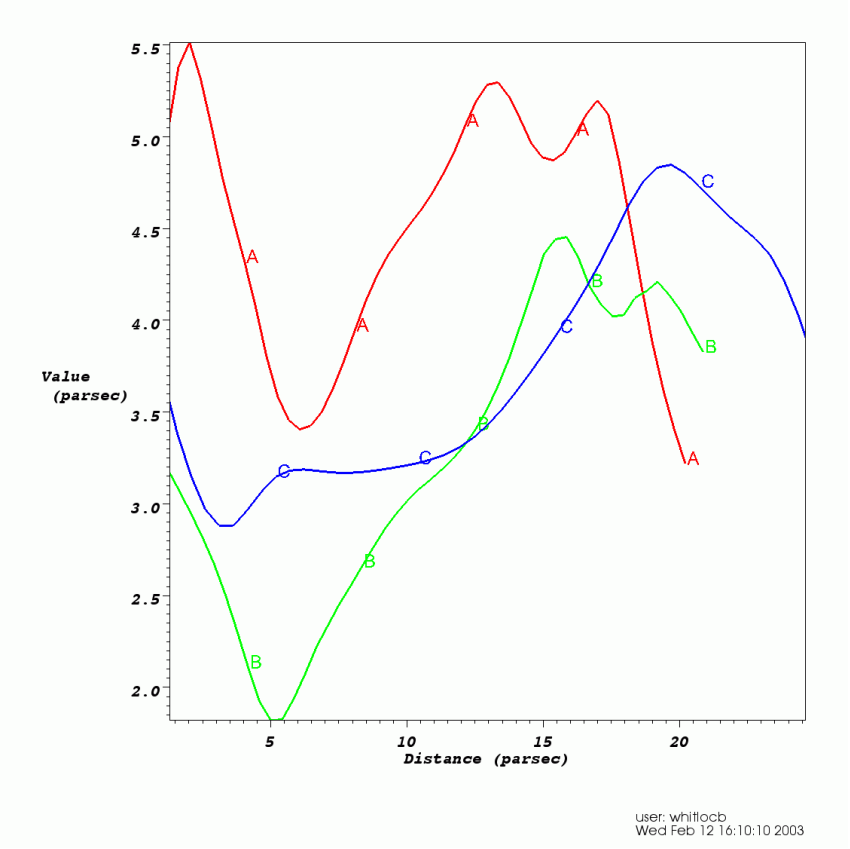
# Advanced Streamline Options

- Choose a parallelization scheme
- Choose streamlines vs pathlines
- Pathlines are streamlines that are integrated through a time-varying vector field



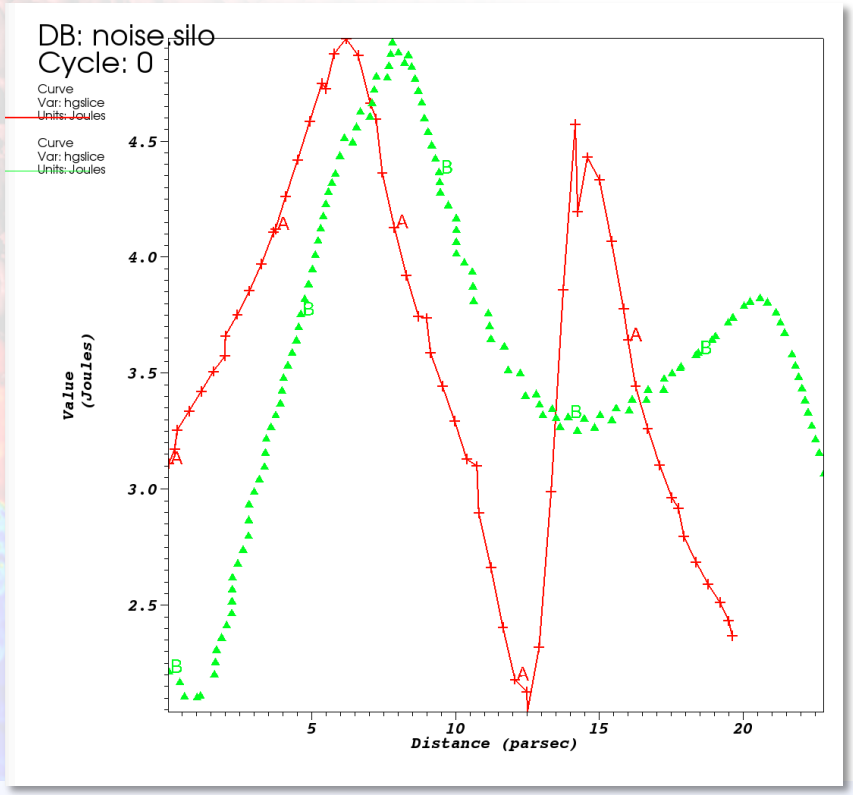
# Curve Plot

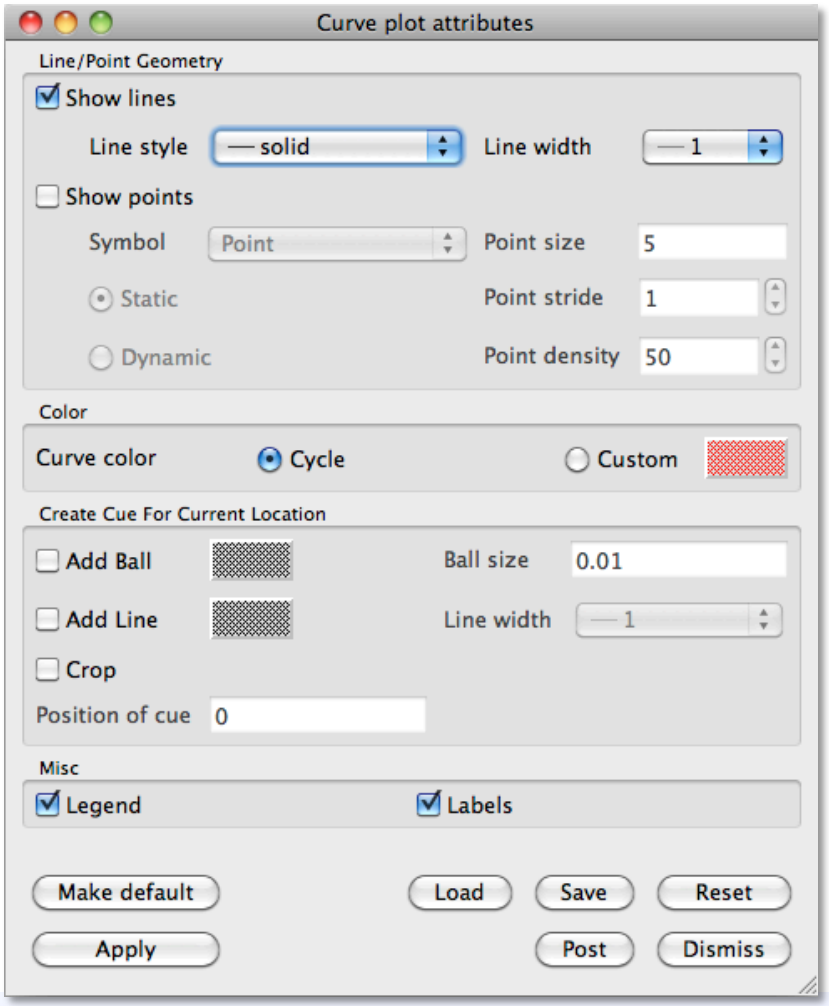
- This plot displays x,y pairs
- Use this plot when you want to plot simple, 1D variables
- This plot can be generated from higher dimensional data in conjunction with the Lineout operator
- This plot accepts curve data



# Curve Plot Attributes

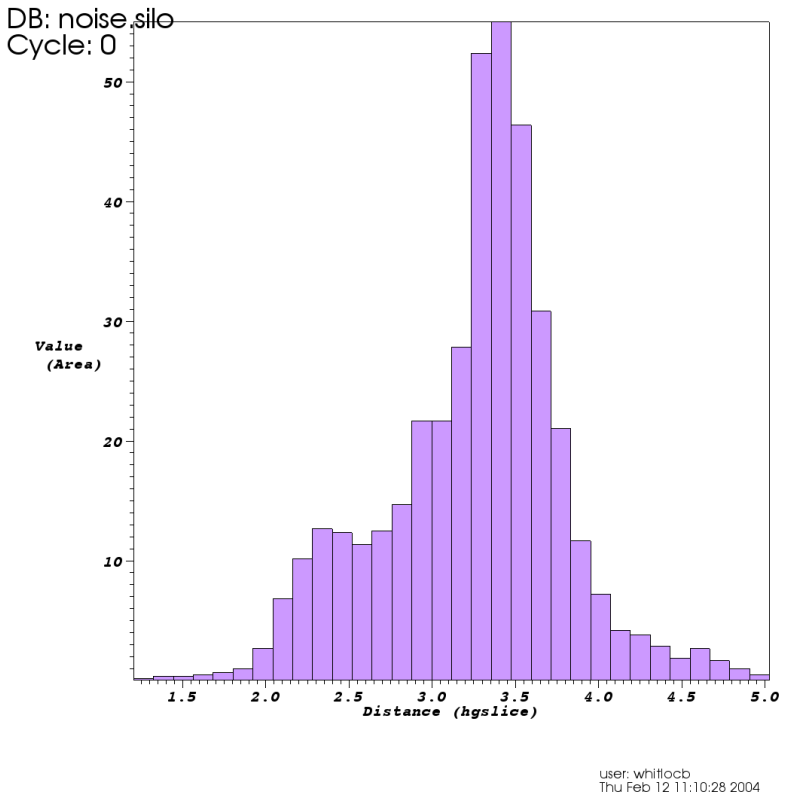
- Curve line and point properties



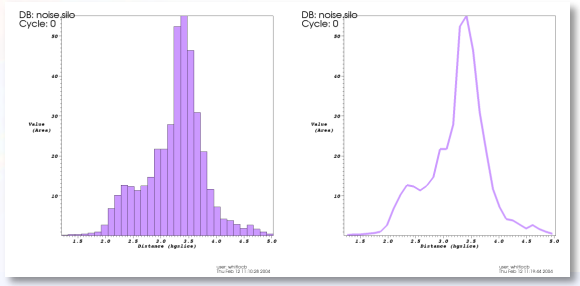
# Histogram Plot

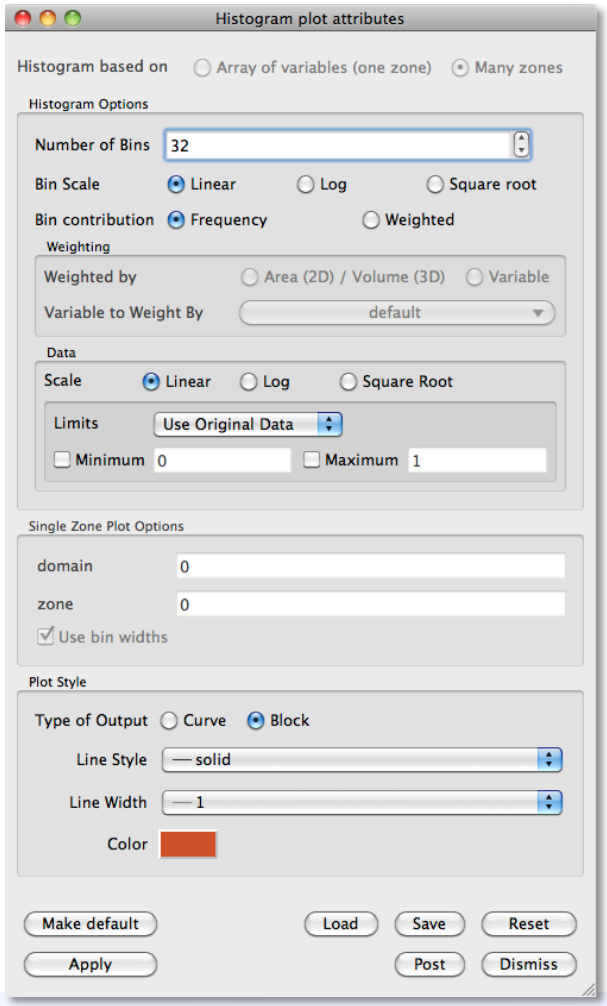
- This plot profiles the data range to determine the distribution of values within that range
- Use this plot if you want to understand how your data is distributed in the data range
- This plot accepts scalar and material variables



# Histogram Plot Attributes

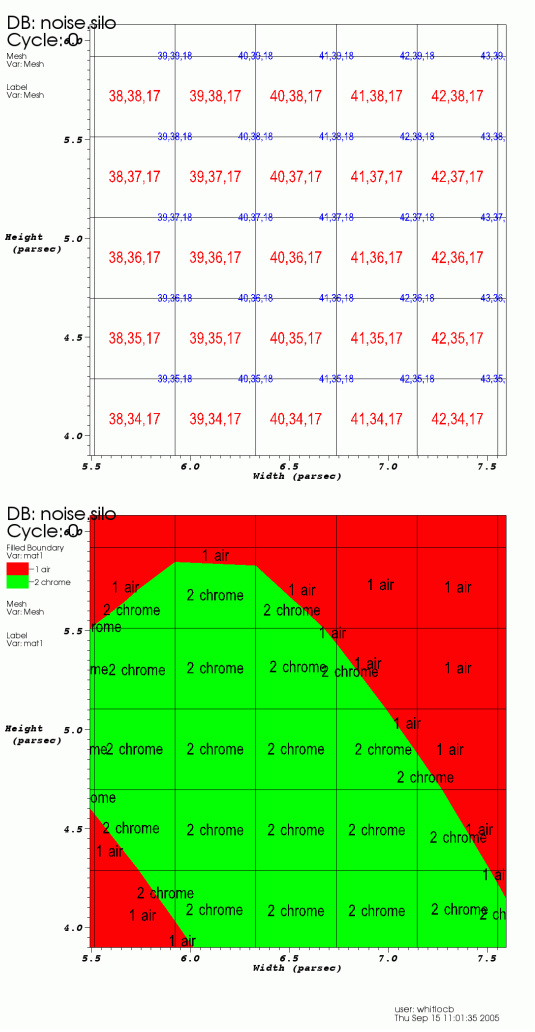
- Bin options
  - Number of bins
  - Weighting
  - Data scaling and limits
- Calculation method
- Plot style



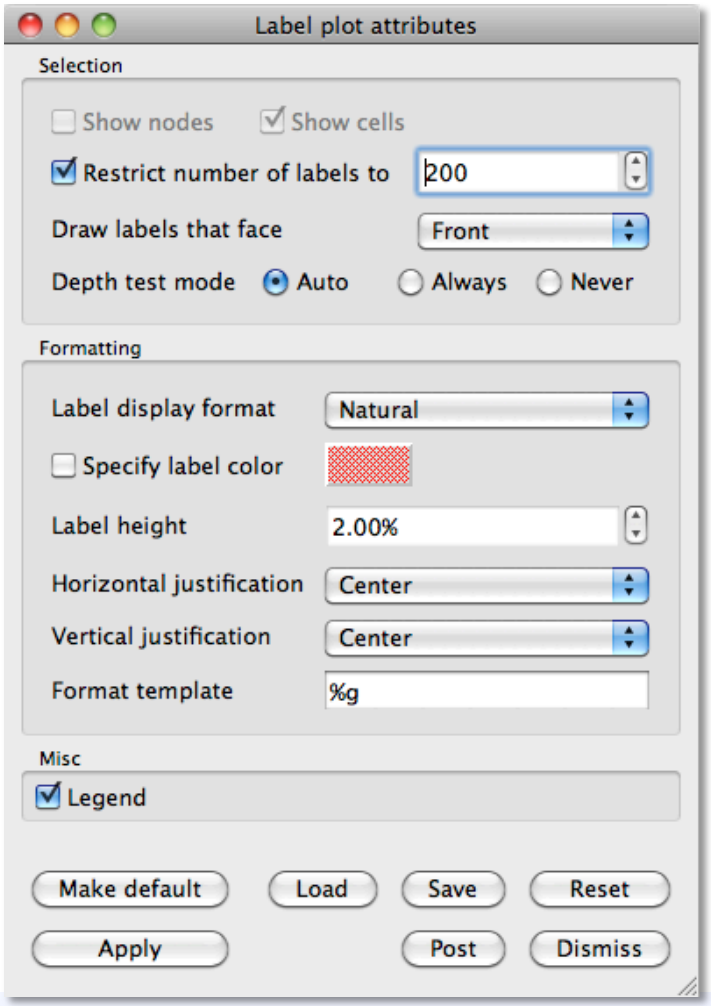
# Label Plot

- This plot draws text labels on each cell or node in the mesh
- Use this plot when you want to see the actual values for a dataset such as when you are visually debugging a simulation
- This plot accepts scalars, vectors, tensors, arrays, materials, and subsets



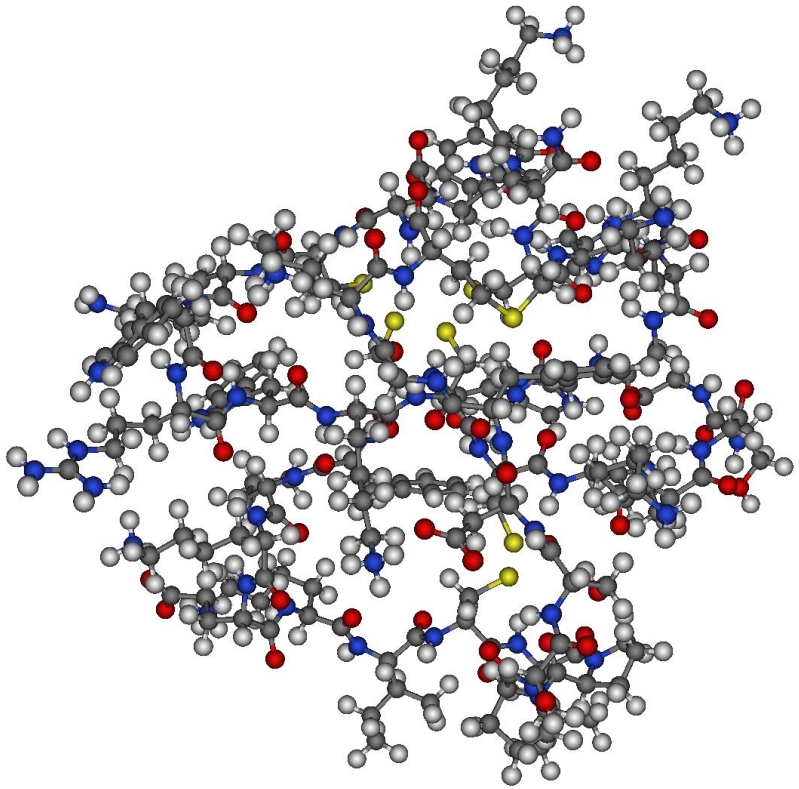
# Label Plot Attributes

- Select nodes, cells
- Restrict number of labels to adaptively restrict which labels are drawn or draw all labels
- Change label colors, size, justification

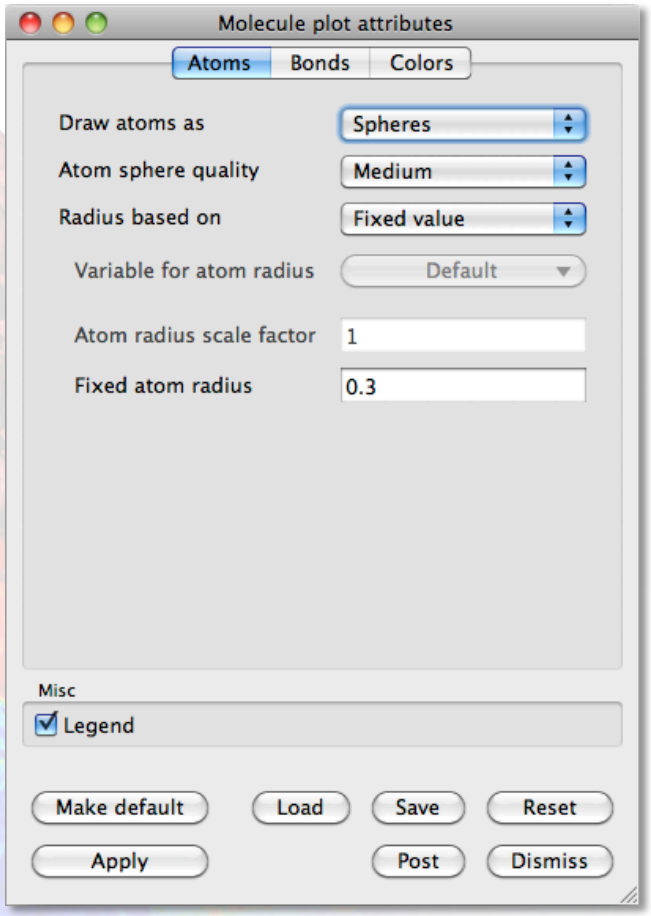


# Molecule Plot

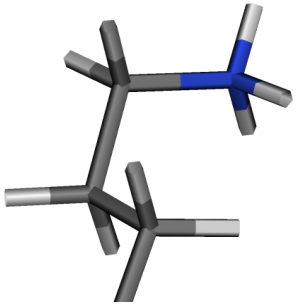
- This plot shows the structure and composition of molecular data
- Use this plot to visualize molecules
- This plot accepts molecular data (scalars on a point mesh with additional bond information)



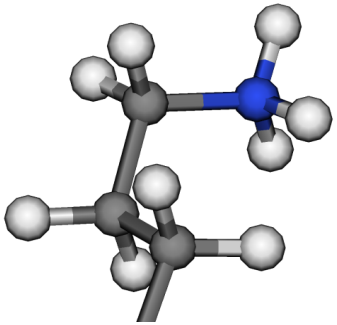
# Atom Properties



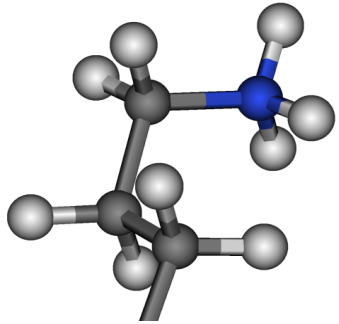

None



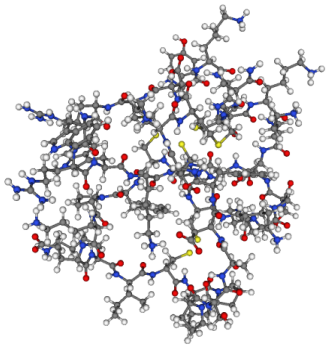
Sphere



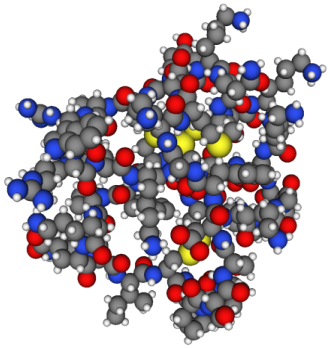
Sphere imposter



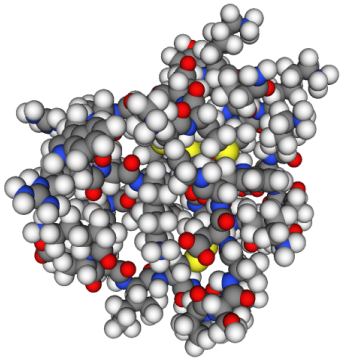
Fixed value



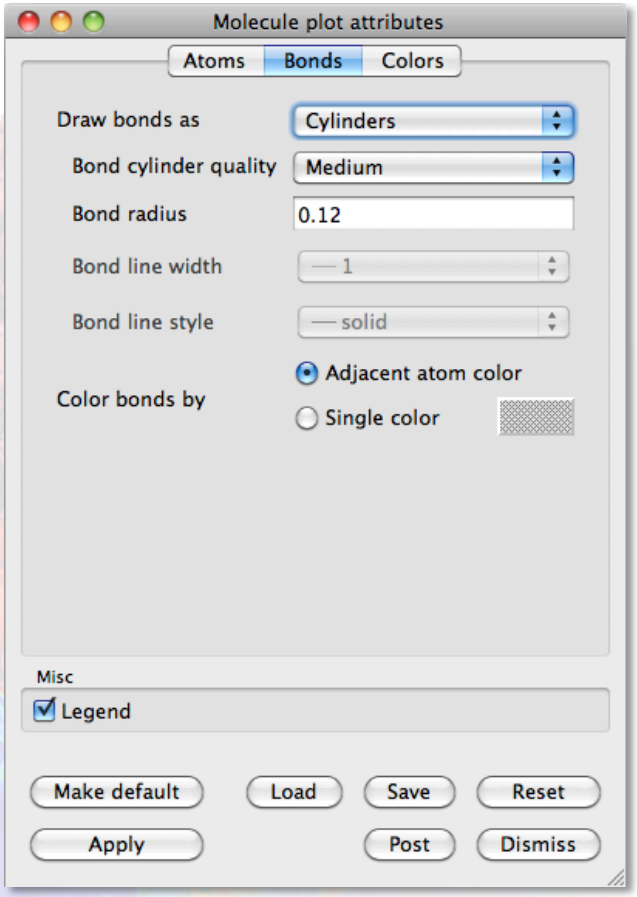
Covalent radius



Atomic radius

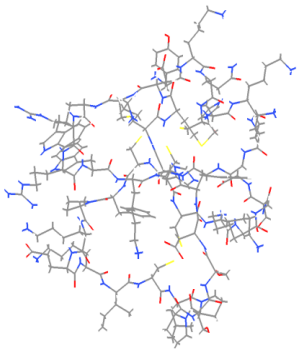


# Bond Properties

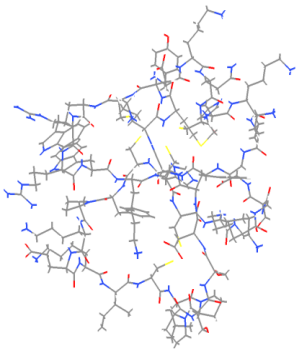



- Drawing method
  - None
  - Lines
  - Cylinders
- Lines
  - Change line width
  - Change line style
- Colors
  - Color by atom color
  - Use a single color

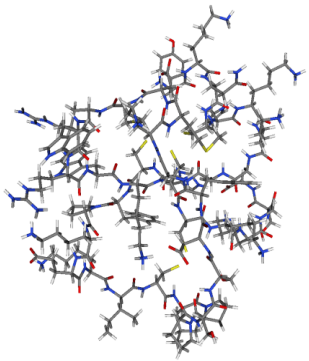
Lines



Lines (dashed)

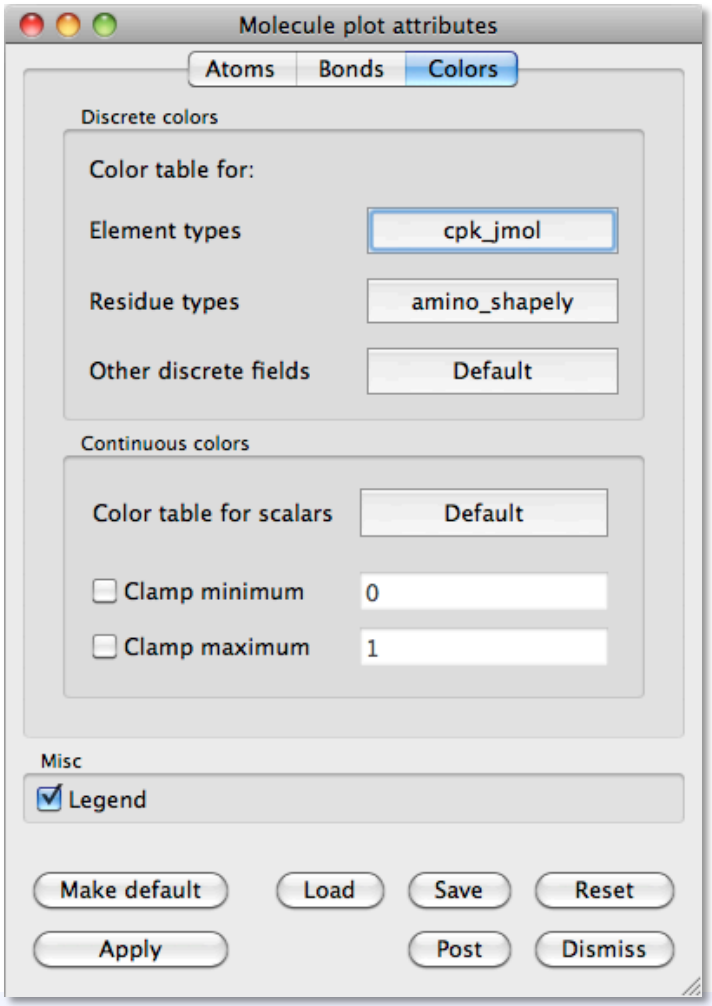


Cylinders



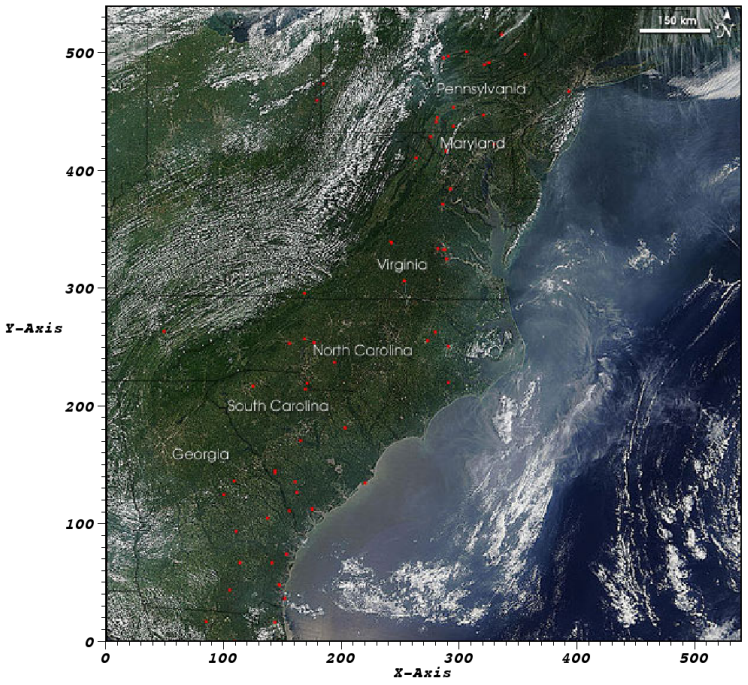
# Molecule Plot Colors

- 3 different discrete coloring schemes can be selected depending on what type of data is plotted
  - Element types
  - Residue types
  - Other discrete fields such as sequence id's
- Continuous coloring scheme for fields such as "backbone", "charge", etc.



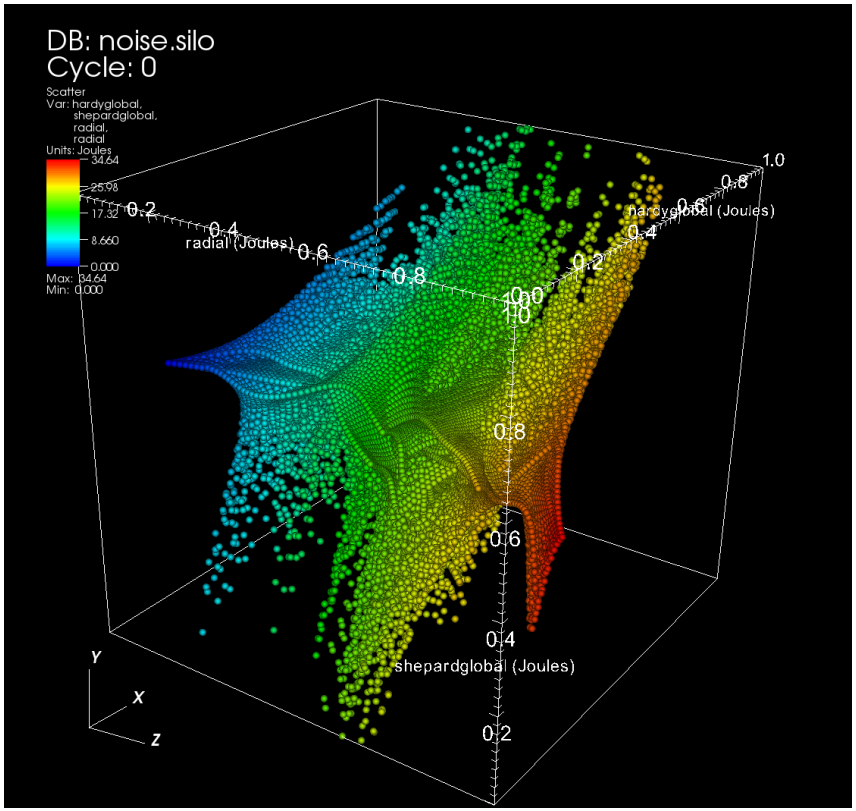
# Truecolor Plot

- The Truecolor plot lets you insert images or geometry that uses RGB colors that are specified in the dataset
- Use the Truecolor plot to incorporate additional detail or to provide frame of reference for your visualization
- This plot accepts colors, which are represented as 4-tuple vectors in the range [0,255]



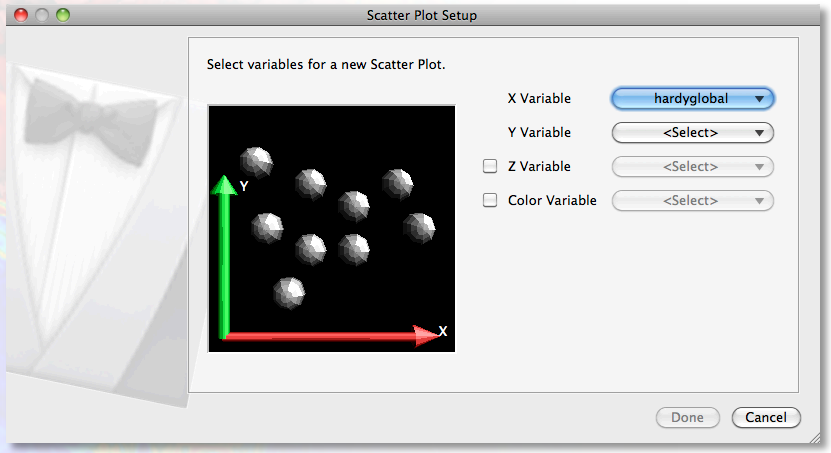
# Scatter Plot

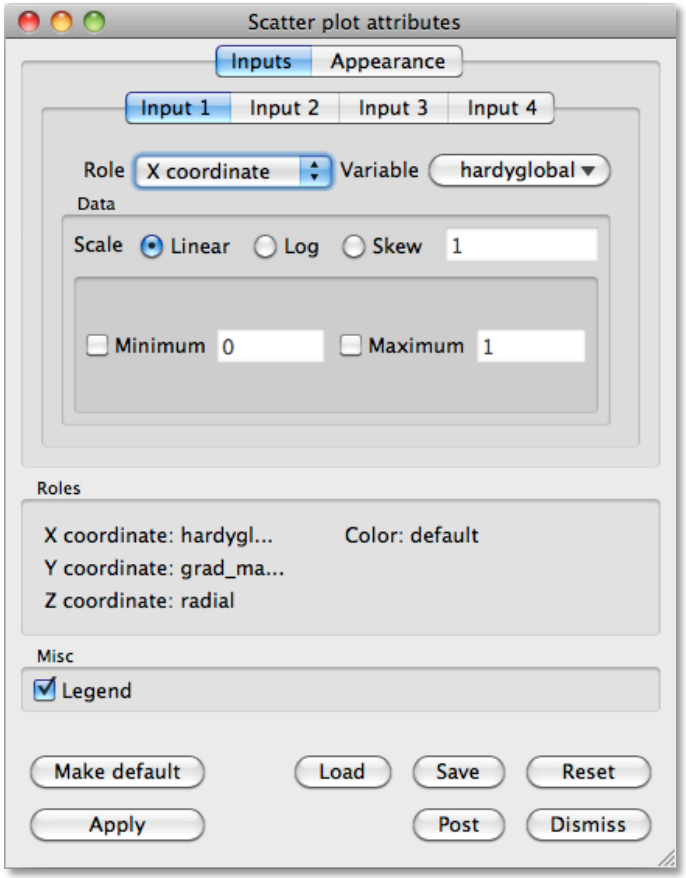
- The Scatter plot lets you use multiple scalar variables to create a point mesh, showing you relations between the variables
- 2 or 3 scalars can be used to create coordinates for points
- 1 additional scalar may be used to color the points



# Scatter Plot Windows

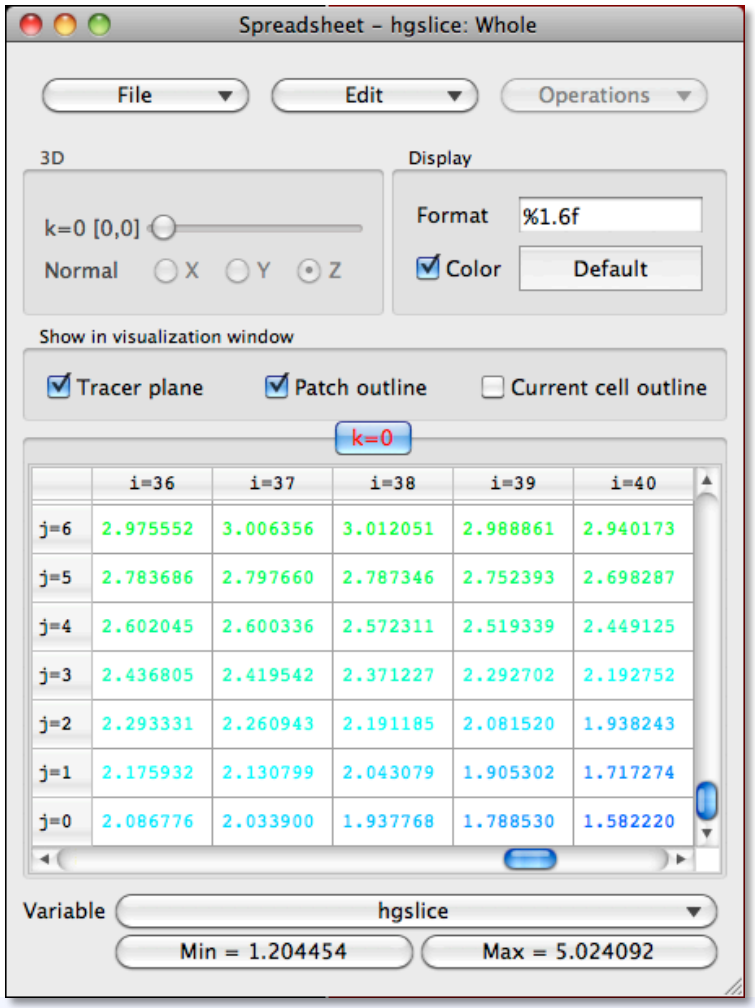
- Wizard helps set up plot
- Plot attributes window lets you decide which scalars are used for coordinates and colors
- Plot attributes window provides controls over plot appearance



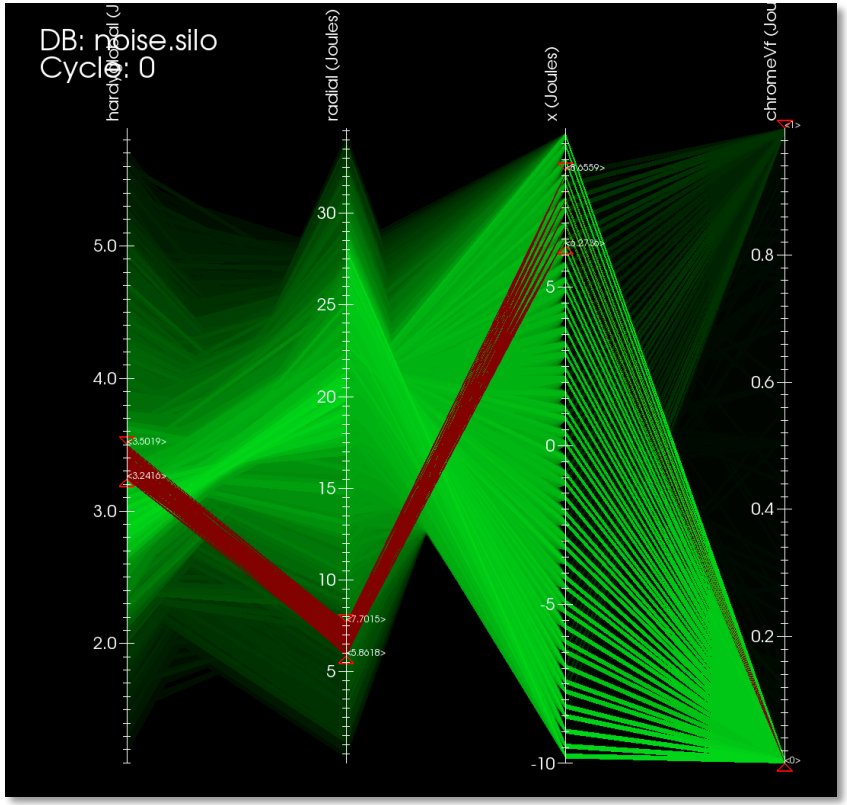
# Spreadsheet Plot

- Spreadsheet plot opens a new window that lets you inspect data in spreadsheet form
  - One domain at a time
  - Shows slice representation in vis window
  - The plot ***is*** the new window
- Select spreadsheet cells
  - Sum
  - Average
  - Export to text file
- Use this plot with scalar values



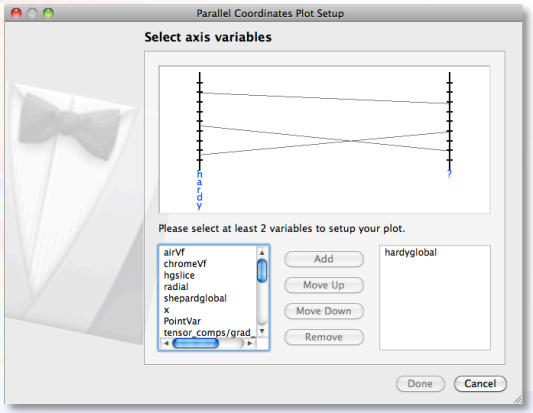
# Parallel Coordinates Plot

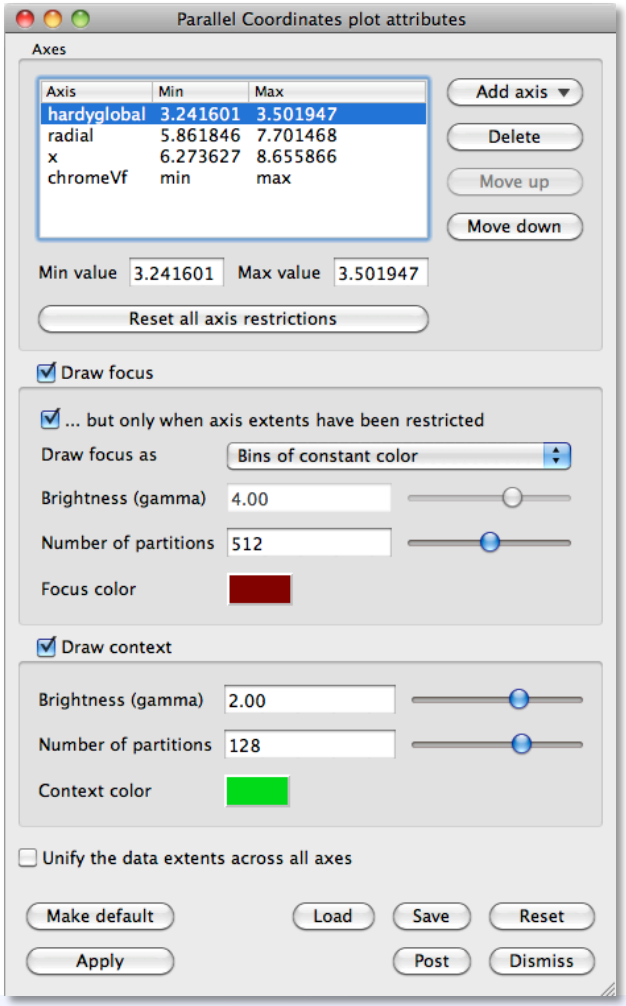
- Examine potential links between several variables
- Draw line from cell to cell in each axis
- Paths that are used by more cells are brighter
- Restrict ranges on each axis
- Use this plot with scalar variables



# Parallel Coordinates Plot Attributes

- Set up the plot using a wizard
- Set up the variables that will be used as axes
- Control focus parameters
- Control context parameters



# Exercise Group 3

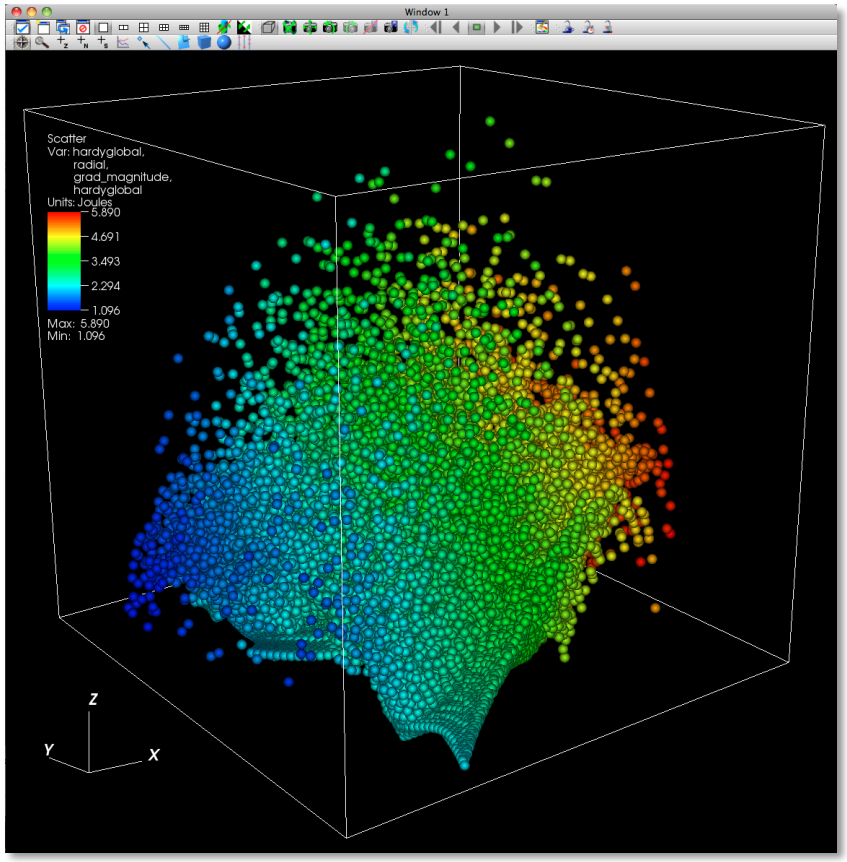
# Visualization Windows

# Lesson Goals

- By the end of this lesson, you will be able to
  - Use the popup menu and the toolbar
  - Manage vis windows
  - Add a new vis window
  - Delete a vis window
  - Clear plots from vis windows
  - Change window layouts
  - Copy window attributes
  - Lock vis windows together

# Visualization Window

- AKA “vis” window, is a window that displays plots and allows you to interact with them using the mouse
- Allows direct manipulation of plots
- Provides a popup menu and toolbar
  - Switch window modes
  - Activate interactive tools
  - Perform commonly used operations

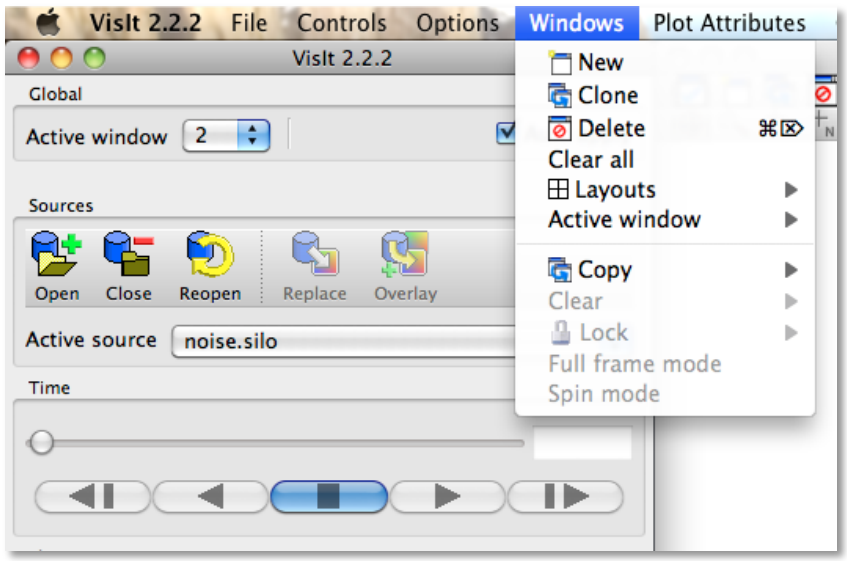


# Managing Visualization Windows

- VisIt allows you to create up to 16 vis windows
- To manage those vis windows, VisIt provides controls to
  - Add a new vis window
  - Remove a vis window
  - Change the vis window layout

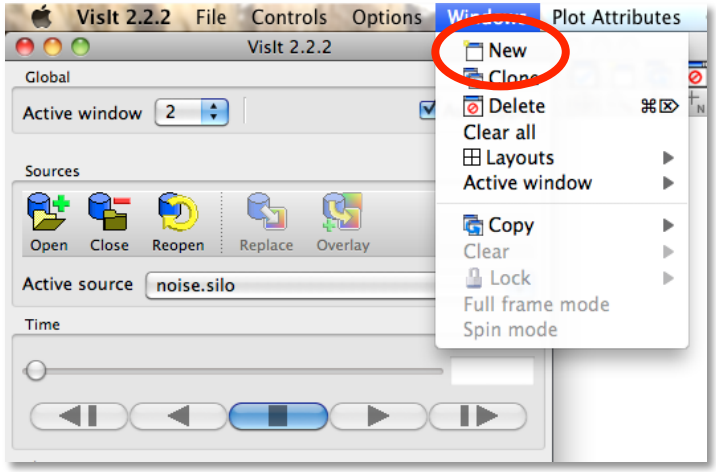
- The controls for managing vis windows are located in the Main Window's Windows menu, as well as in the vis window's Toolbars and Popup menu

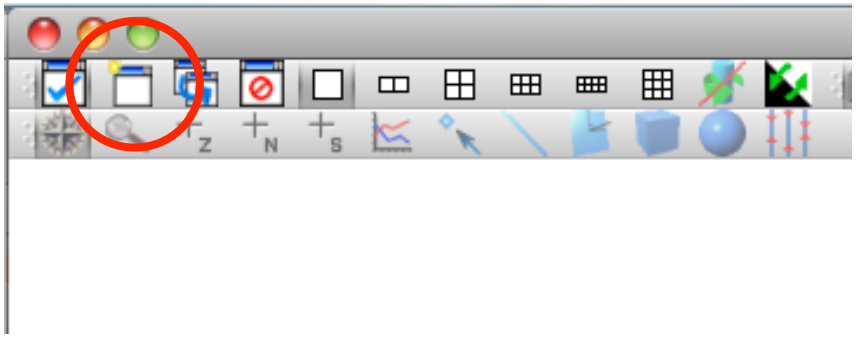
Windows menu



# Adding a New Visualization Window

- Add a new vis window by selecting the New option from the Main Window's Windows menu
- You may also click the New Window icon in the vis window's Toolbar or select the New Window option from the Windows submenu in the Popup menu



# Cloning the Active Visualization Window

- Cloning the active window creates a new vis window with the same plots and settings as the active vis window
  - Plots
  - Annotations
  - Lighting
  - Window modes and settings
- Select the Clone option from the Main Window's Windows menu or click the Clone window icon in the vis window's Toolbar
- Plots in the cloned window are only copied. They are not generated
  - Their plot list entries in the Plot list are green
  - Click the Draw button in the Main window to make VisIt generate the plots

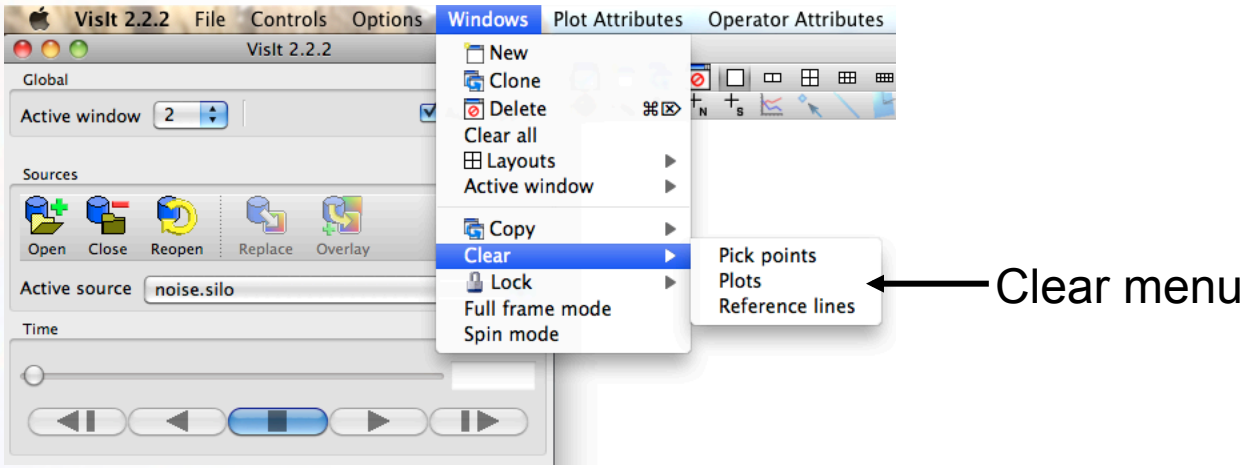
# Deleting a Visualization Window

There are 4 ways to delete a vis window.

1. Select the Delete option from the Main Window's Window menu
2. Click on the Close Window button in the window decorations provided by the windowing system
3. Click on the Delete Window icon in the vis window's toolbar
4. Use the Delete option in the vis window's Popup menu

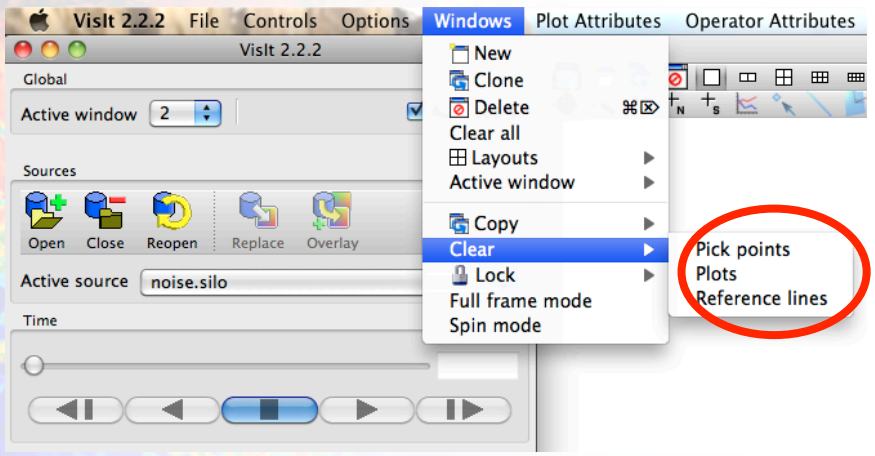
# Clearing Plots from Visualization Windows

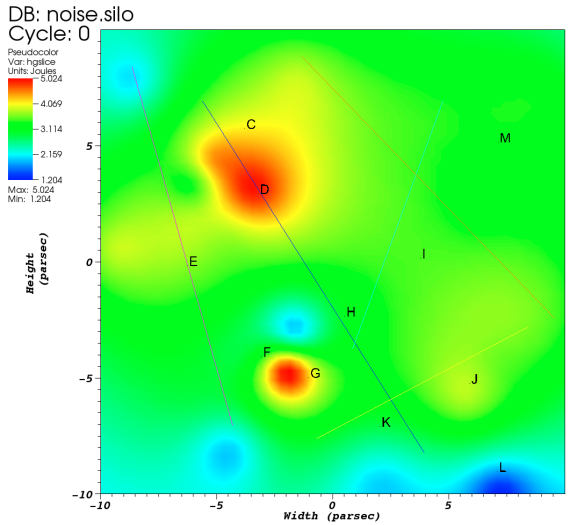
- Clearing plots discards their geometry and puts them back in the new state.
- The Main Window's Windows menu provides a Clear All option that you can use to clear the plots from all vis windows
- You can also clear the plots for just the active window by selecting the Plots option from the Clear submenu in the Main Window's Windows menu



# Clearing Pick Points from a Visualization Window

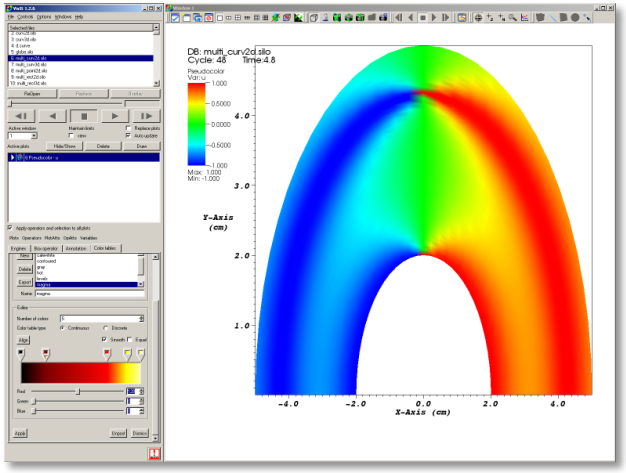
- A pick point is a marker that VisIt adds to a vis window when you click on a plot in pick mode
- A reference line is a line that you draw in a vis window when it is in lineout mode
- Clear these markers by selecting the Pick points or Reference lines options from the Clear submenu in the Main Window's Windows menu

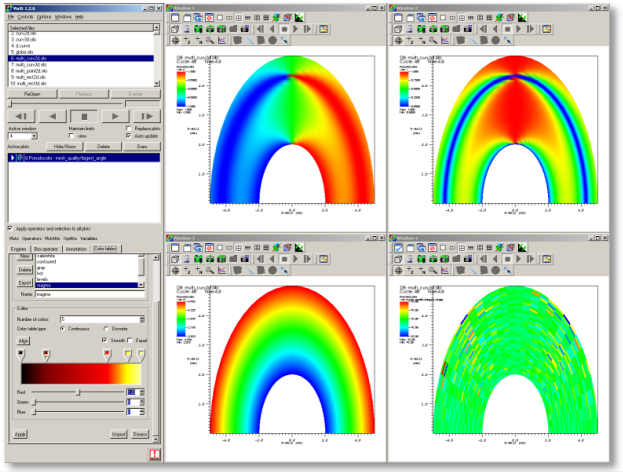


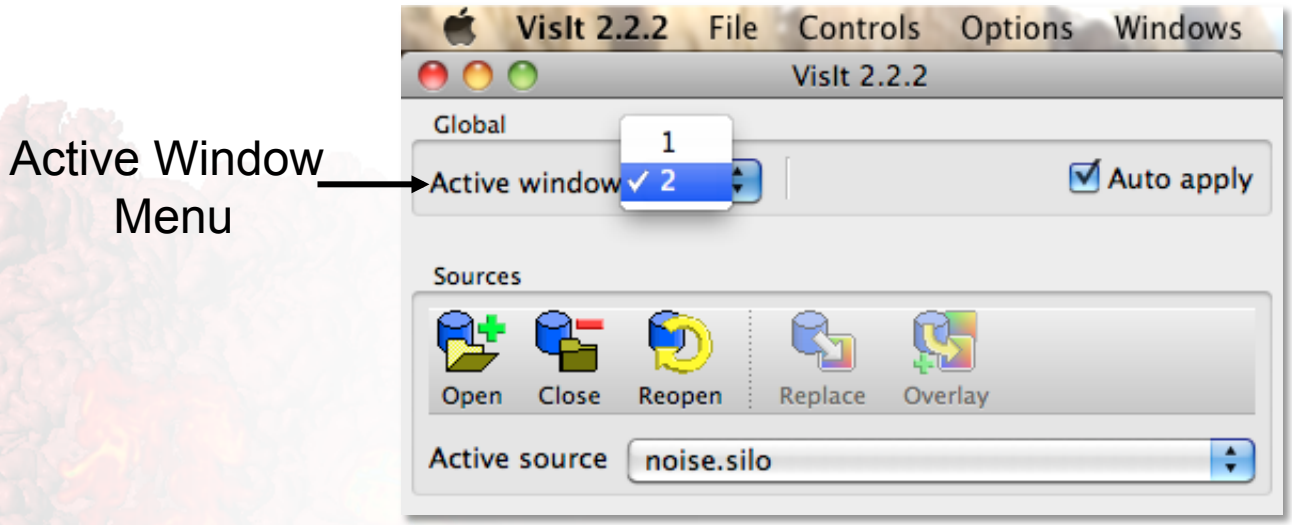
# Changing Window Layouts

- Use window layouts to manage multiple vis windows
- Changing window layout typically resizes all of the vis windows and moves them into a tiled formation
- If there are not enough vis windows to complete the desired layout, VisIt creates new vis windows until the layout is complete



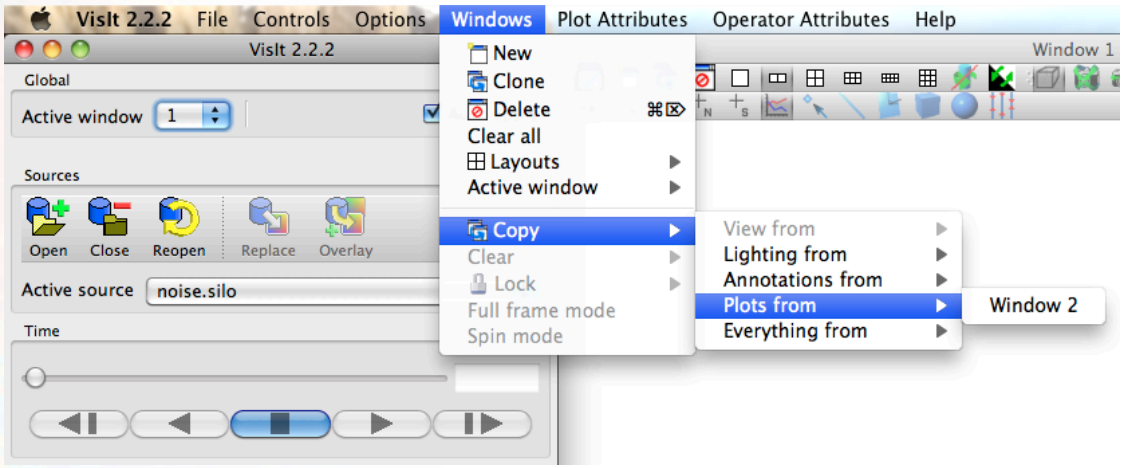
# Setting the Active Window




- Select a window number from the Active window menu
- Click the Active window icon in the vis window's Toolbar
- Setting the active window updates the GUI so that it displays the state for the new active window
  - You can only set attributes for plots in the active window

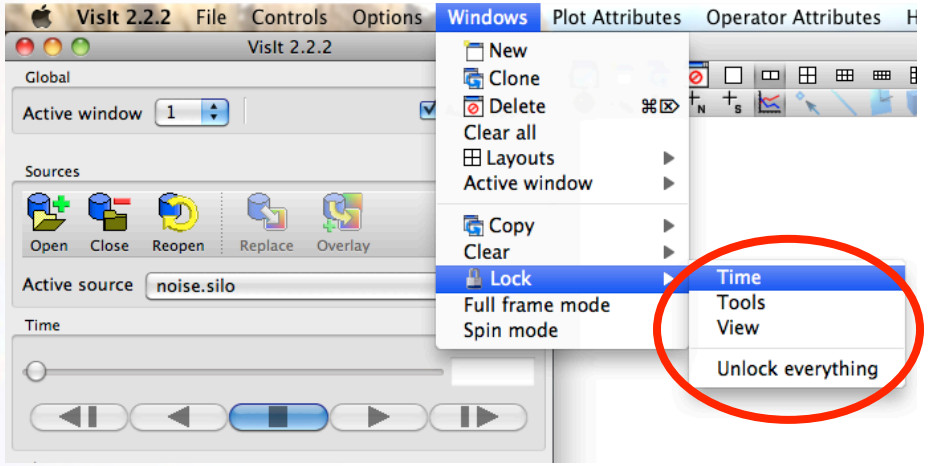
# Copying Window Attributes

- VisIt allows you to copy window attributes and plots between windows
- Useful when comparing plots generated from similar databases
- The Copy menu provides a list of available vis windows from which attributes can be copied



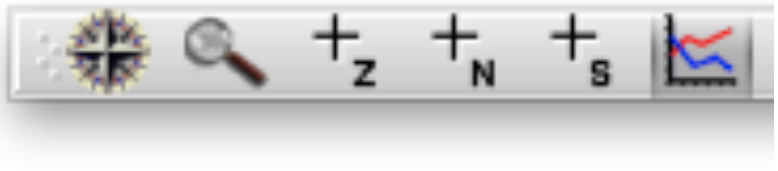
# Locking Vis Windows Together

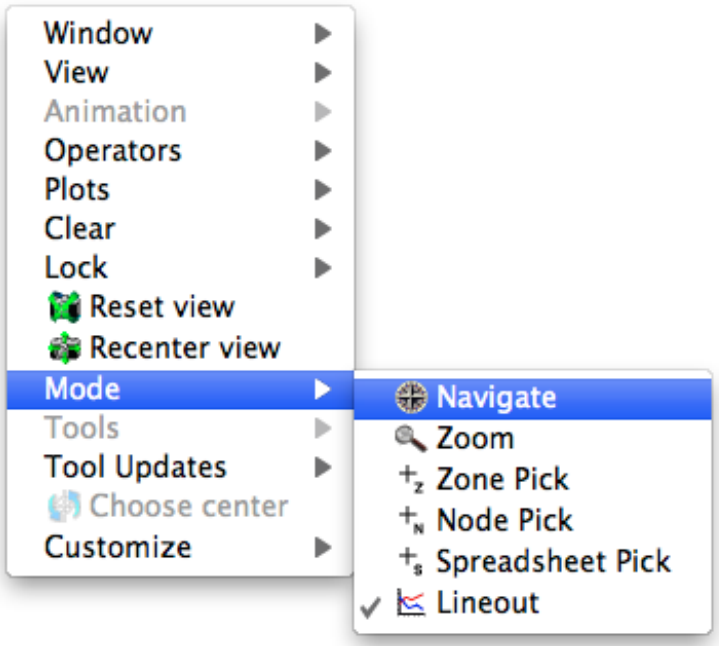
- Vis windows can be locked together
  - Lock in time so changing times in one window affects other locked windows
  - Lock tools together so tool updates in one window affect other locked windows
  - Lock views so changing views in one window changes views in other locked windows



# Window Modes

- Vis windows have 5 window modes that determine the behavior of direct interaction
  - Navigate – The default mode
  - Zoom
  - Zone Pick
  - Node Pick
  - Spreadsheet Pick
  - Lineout



# Navigate Mode

- Navigate mode lets you rotate, move, and zoom in on plots
- When the vis window is in navigate mode, clicking the left mouse button and dragging with the mouse will perform an action that moves, rotates or zooms the plot
- You can translate plots by holding down the *Shift key* before left-clicking and dragging the plot
- You can zoom in on plots by clicking the middle button and moving the mouse up or down

# Zoom Mode

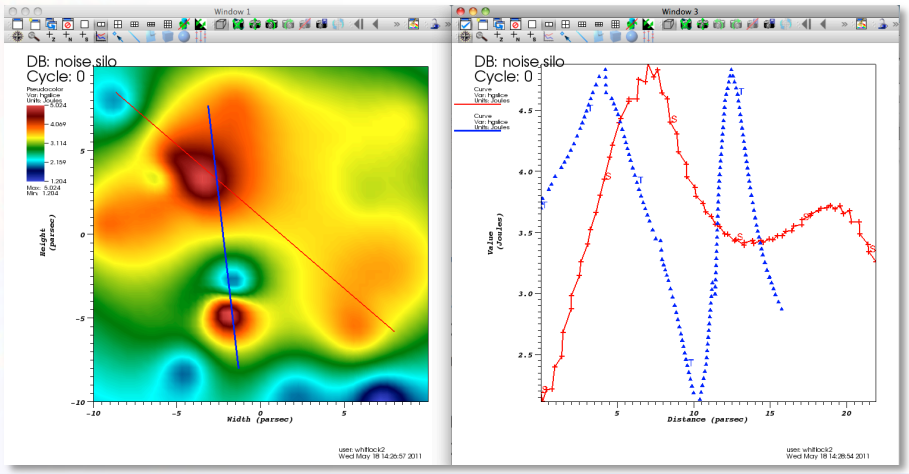
- Press the left mouse button and move the mouse to sweep out a box that will define the area to be zoomed
- Release the mouse button when the zoom box covers the desired area
- Click another mouse button to cancel the zoom
- View changes can also be undone by selecting the Undo view option from the popup menu's View menu

# Pick Mode

- Click on a plot to extract data and print it to the Pick Window
- Zone Pick
  - The value for the cell that contains the clicked point is extracted
- Node Pick
  - The value for the node closest to the clicked point is extracted
- Spreadsheet Pick
  - The value for the cell that contains the clicked point is extracted and a Spreadsheet plot is created, highlighting the clicked cell

# Lineout Mode

- Extract data along a line to produce a one dimensional curve in another vis window
- Click in the vis window and sweep out a line along which to extract data
- When you release the mouse button, VisIt adds a lineout to the vis window and a curve plot is created in another vis window



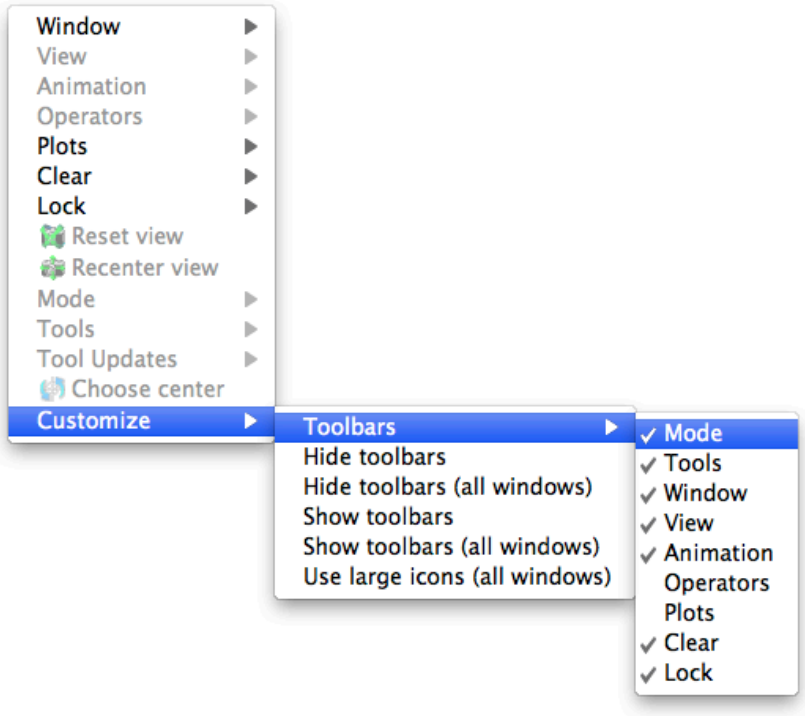
# The Popup Menu & Toolbar

- Each vis window contains a Popup Menu and a Toolbar
- Both perform several categories of operations
  - Window management
  - Activating tools
  - Manipulating the view
  - Playing animations
- Options in the Popup menu exist in the Toolbar and vice-versa
- Access the Popup menu by pressing the right mouse button in the vis window

# Hiding Toolbars

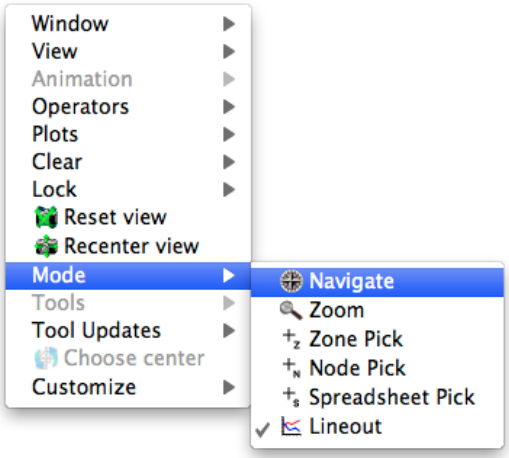
- Customize menu lets you customize the vis window's Toolbar
- To enable or disable individual toolbars, select from the Customize menu and select the toolbars you routinely need
- Save your preferences by using the Save settings option in the Main Window's Options menu so that the next time you run VisIt, it shows only your enabled toolbars

***The Customize Menu:***

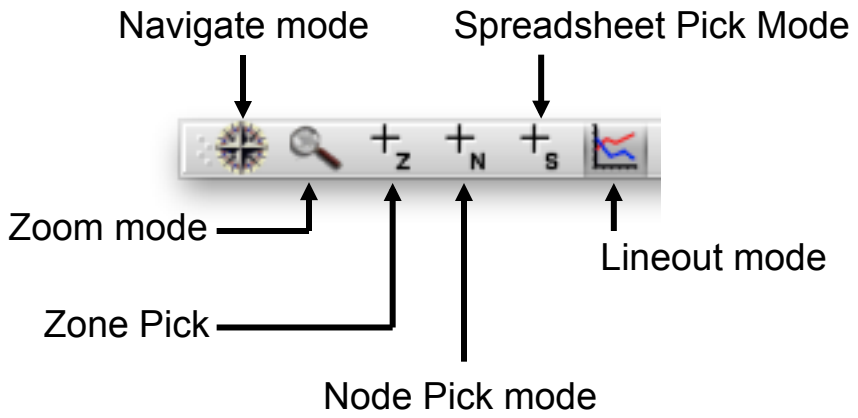


# Switching Window Modes

Mode Menu



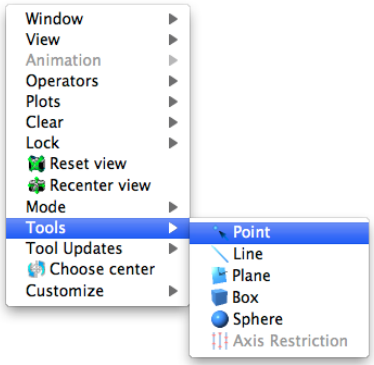

Mode Toolbar



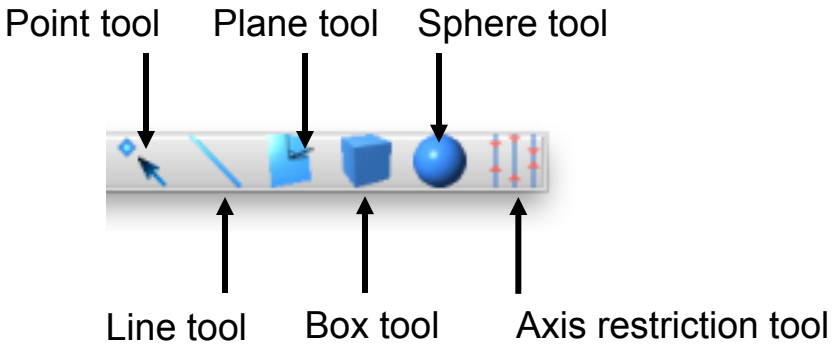

- You can select a window mode from the Mode menu to change the vis window's mode
- You may also use the Mode Toolbar to change the vis window's window mode

# Activating Tools

Tool menu



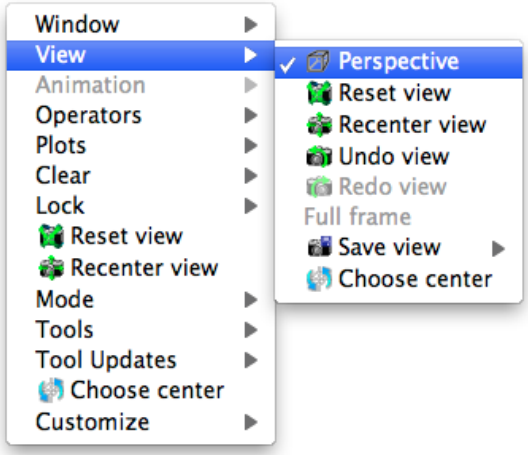

Tool toolbar



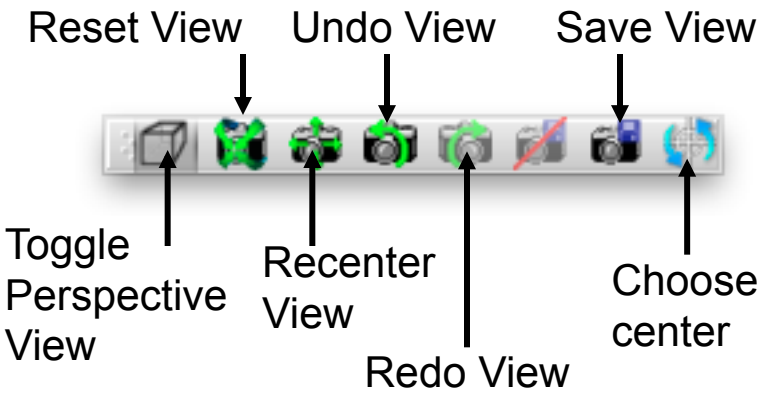

- Tools menu that lists all of VisIt's interactive tools
- To activate an available tool, select it from the Tools menu or click its icon on the Toolbar
- To deactivate a tool, choose the tool you want to deactivate from the View Menu or View Toolbar

# View Options

View Menu



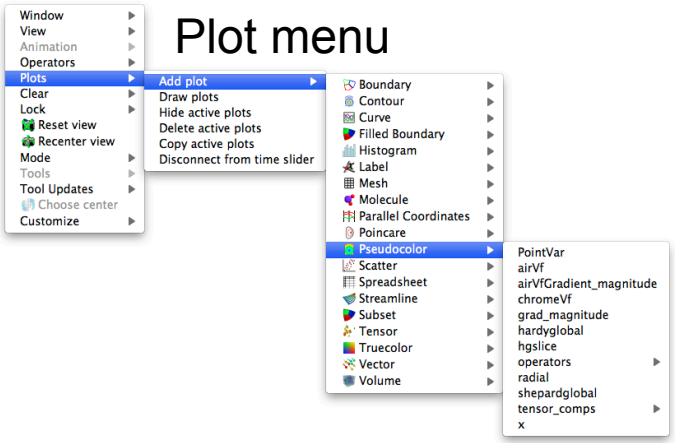

View Toolbar




- VisIt's Popup menu and Toolbar have several options that are available for manipulating the view
- You can reset the view, recenter the view, undo a view change, toggle perspective viewing, or you can lock views

# Plots

Plot menu

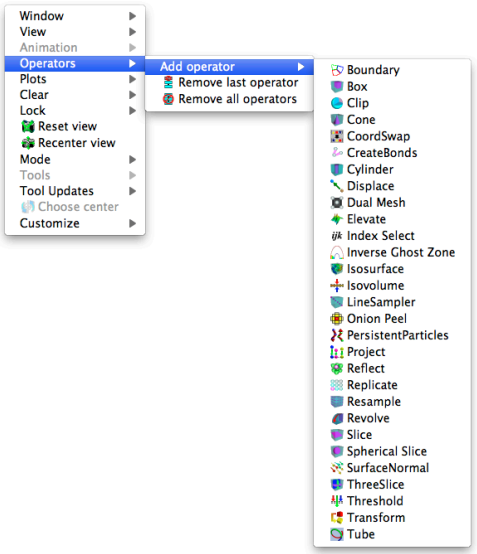



Plot Toolbar

- This Plots menu and toolbar allow you to create new plots using variables from the active database
- The Plots toolbar is not shown by default but use the Customize menu to make it visible

# Operators

Operators menu

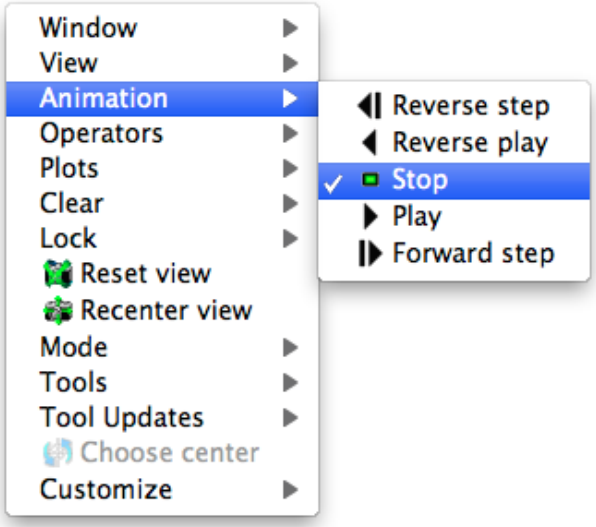



Operators toolbar

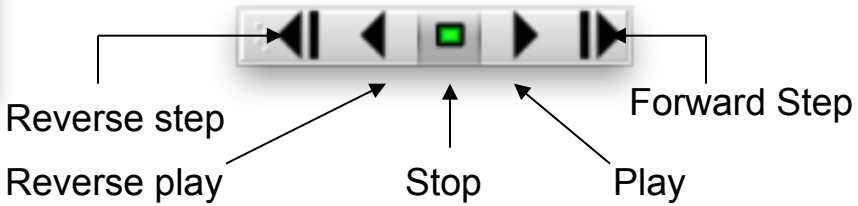
- Add operators to the currently selected plots
- Remove operators from the currently selected plots
- The operators toolbar is not shown by default but use the Customize menu to make it visible

# Animation Options

Animation menu



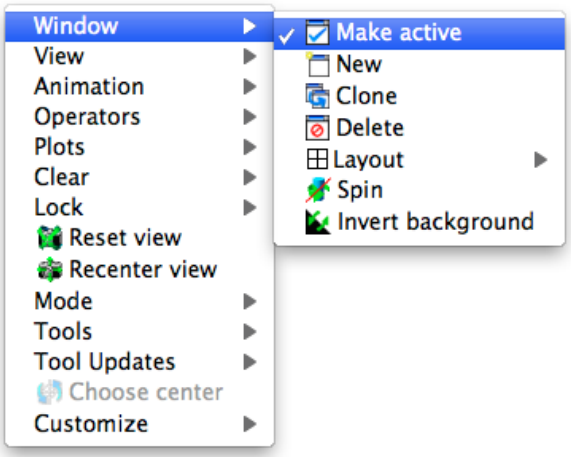

Animation toolbar



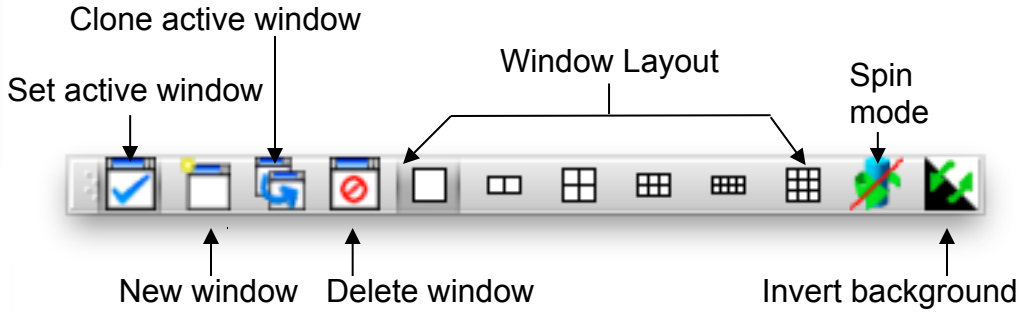

- VisIt's Animation Menu and Toolbar provide options for playing and stepping through animations
- The Animation Icons resemble VCR buttons and function similarly
- You can Reverse Step, Stop, Forward Step, Reverse Play or Play

# Window Options

Windows menu




Windows toolbar




VisIt's Windows Menu and Toolbar have several options to manipulate the windows within your visualizations

- Set the active window
- Clone the active window
- Change window layout
- Engage spin mode
- Bounding-box mode
- Invert window's background
- Delete a window
- Create a new window

# Exercise Group 4

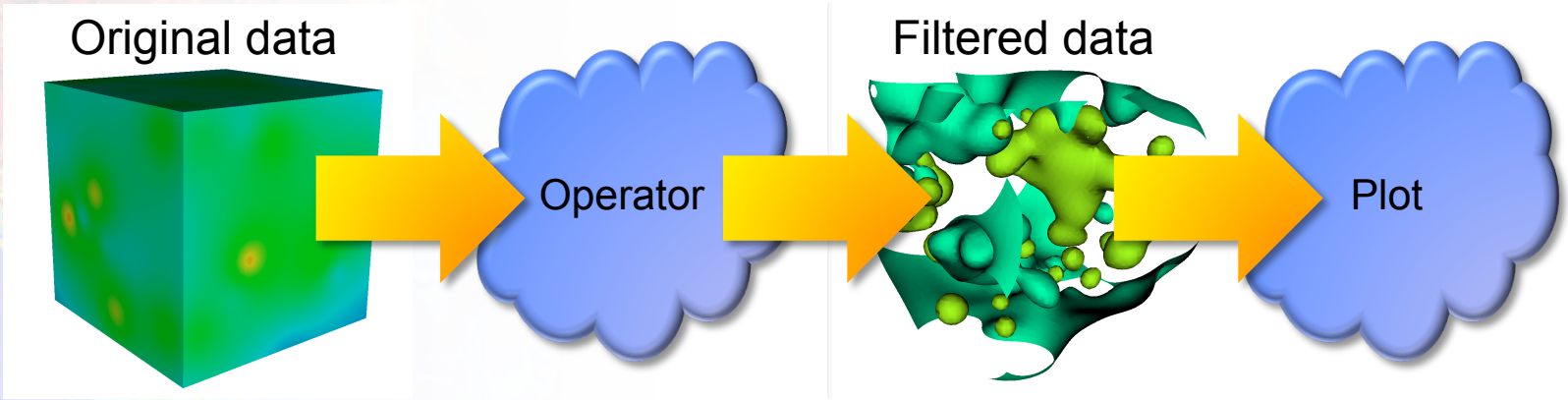
# Operators

# Lesson Goals

- By the end of this lesson, you will know:
- How to add or remove operators
- The purpose for each operator
- When and how to use each operator

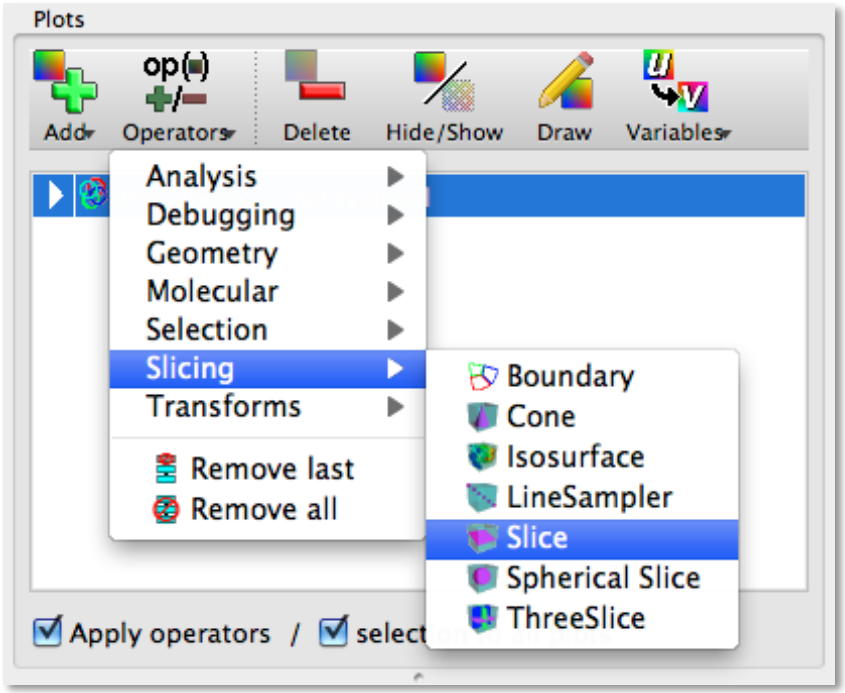
# What is an Operator?

- An operator is a filter that is applied to a database variable before the compute engine uses that variable to generate a plot
- Operators come from plug-ins so you can extend VisIt's data manipulation capabilities by writing a new plug-in



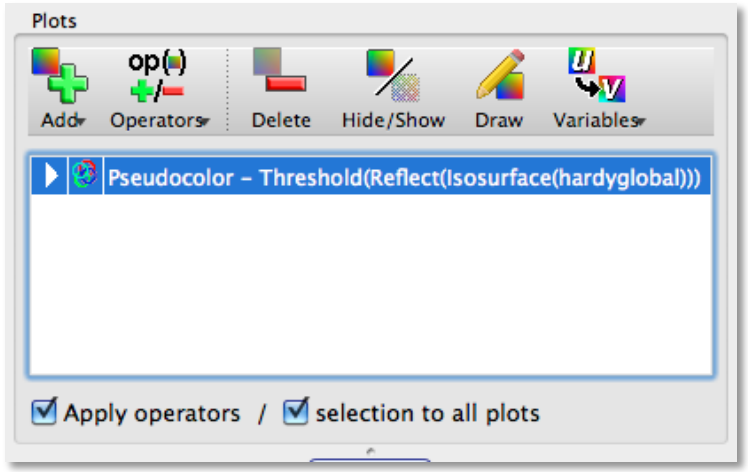
# Adding an Operator

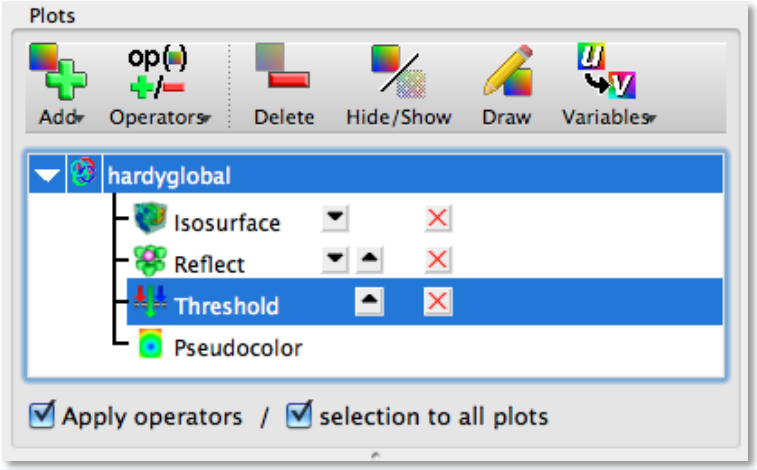
- Operator menu in the Main window allows you to add an operator to an existing plot
- Several operator categories
- Operators can be added for all plots or just for the selected plots
- If the *"Apply operators"* check box is on, operators are added to all plots in the plot list
- If you add an operator to a plot that is in the completed state, it will force the plot to be regenerated on the compute engine



# Adding an Operator

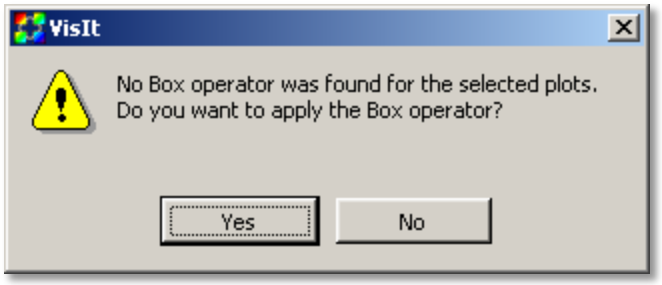
- Multiple operators can be added
- When a plot entry is collapsed, all operators appear in the name of the variable being plotted
- When a plot entry is expanded, the operators appear one after the other
- The operators nearest the database variable are executed first and the output is passed into the next operator before finally arriving at the plot, which makes the processed data visible in the vis window



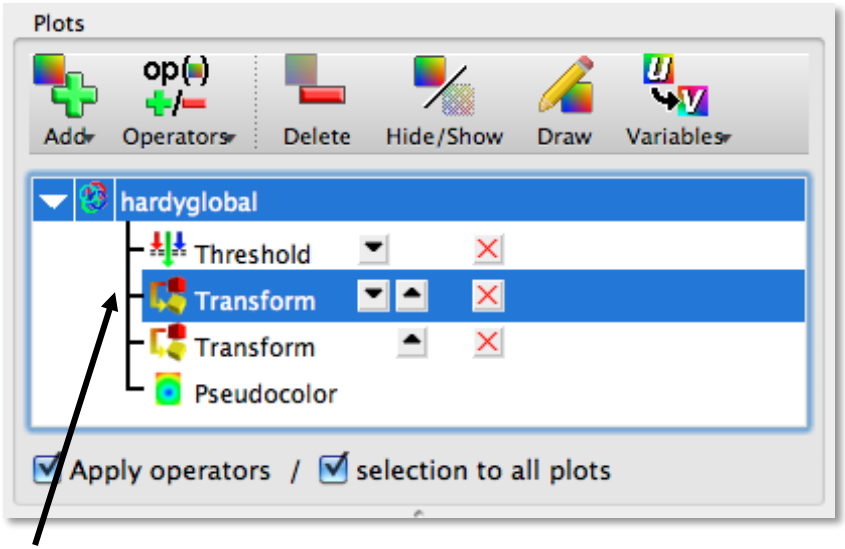
# Adding an Operator

- Most often, it is necessary to change the operator attributes before regenerating the plot
- Setting the operator attributes instead of applying an operator will prompt you to add the operator with the new operator attributes
- Results in fewer regenerations of the plot since the operator attributes are correct



# Active Operator

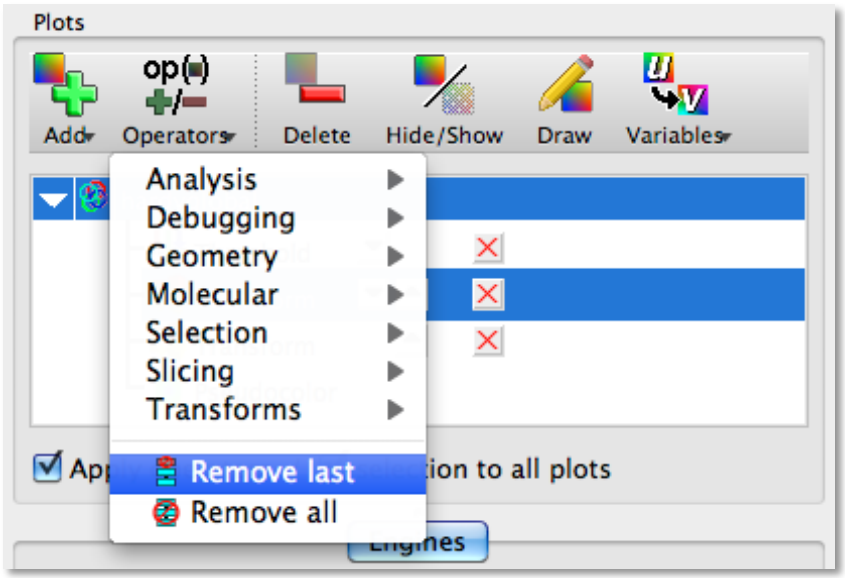
- VisIt allows you to add the same operator multiple times
  - You might want to add the Transform operator or Reflect operator multiple times
- The operator that was added last is the active operator
- You can set the active operator by clicking on and operator when a plot entry is expanded
- When there are multiple instances of the same type of operator, VisIt will only set the operator attributes for the active operator




Active operator

# Removing Operators

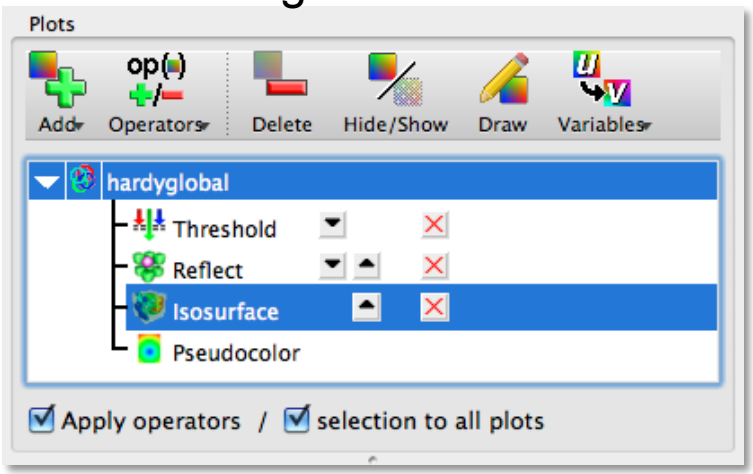
- Sometimes you need to remove an operator from a plot
  - Suppose you sliced a 3D plot and then you want to look at it in 3D again
  - VisIt lets you remove operators so you can do this
- Remove the last operator by choosing “Remove last” from the Operators menu
- Remove all operators by choosing “Remove all” from the Operators menu
- Operator removal rules are the same as for adding operators



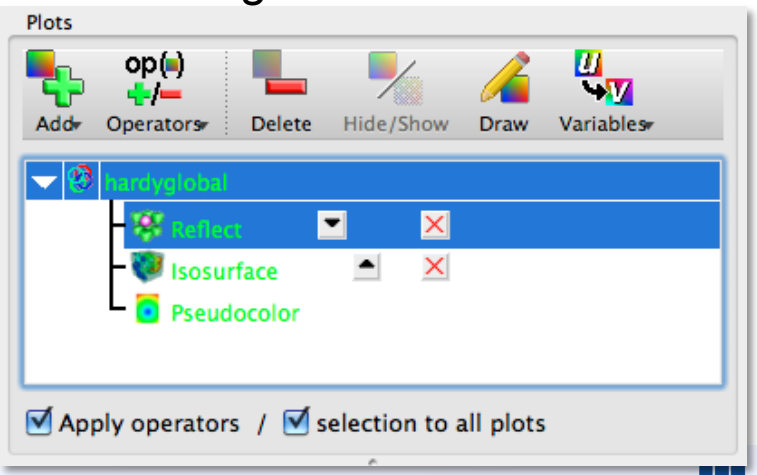
# Removing Operators

- Sometimes it is necessary to remove an operator other than the last operator that was added
- VisIt lets you remove any operator by clicking the red "X" delete button next to the operator name in an expanded plot entry
- When you remove an operator in this manner, the plots are not regenerated unless you have Auto update mode turned on

Before deleting Threshold



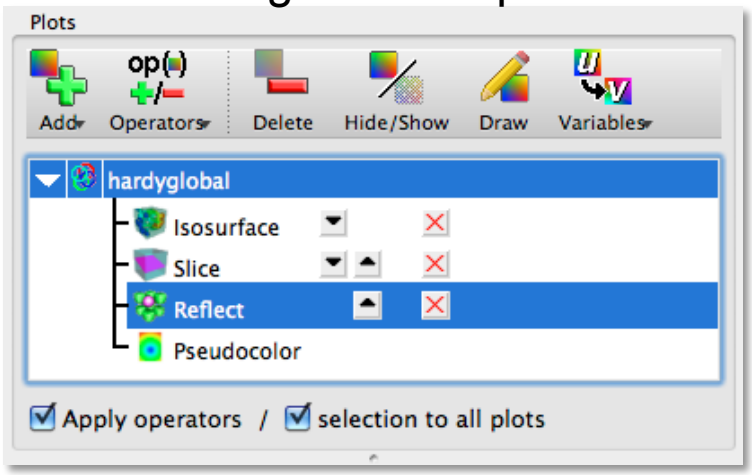

After deleting Threshold



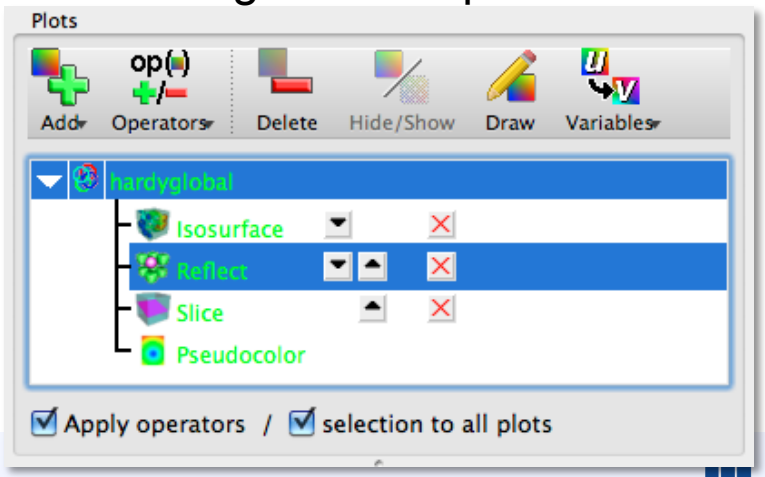
# Changing Operator Order

- You might want to change operator order sometimes since not all operators are commutative
- VisIt lets you change the order of operators by providing up and down buttons next to the operator name in an expanded plot entry
- Click on an operator's down button to move it to later in the pipeline
- Click on an operator's up button to make move it up in the pipeline so it is processed sooner
- When you move an operator, the plot is not regenerated unless you have Autoupdate mode turned on

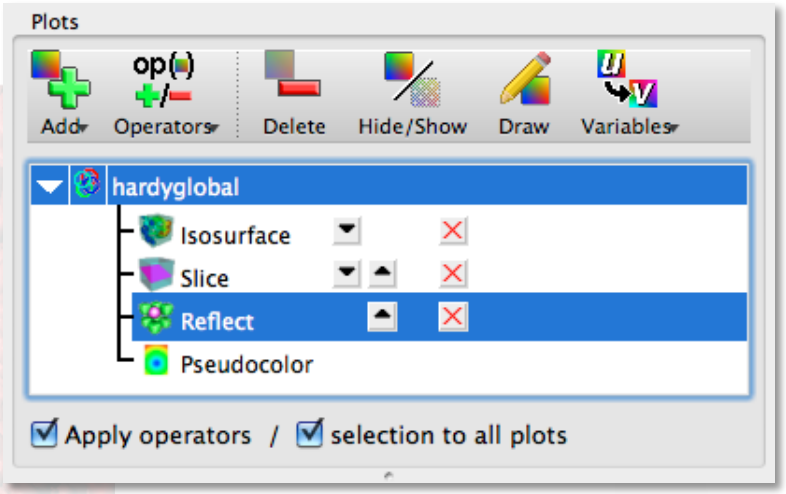
Before moving Reflect operator

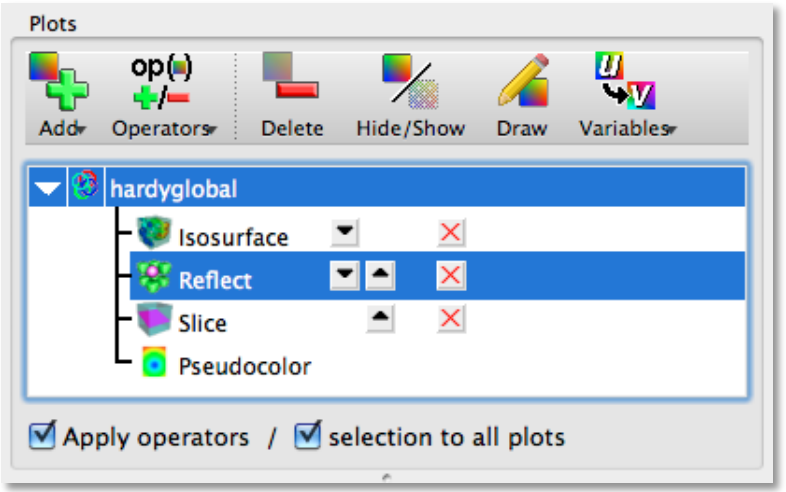


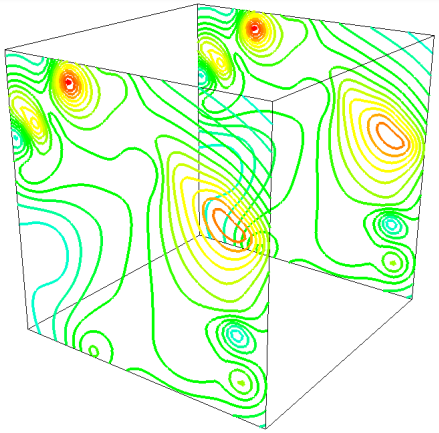

After moving Reflect operator

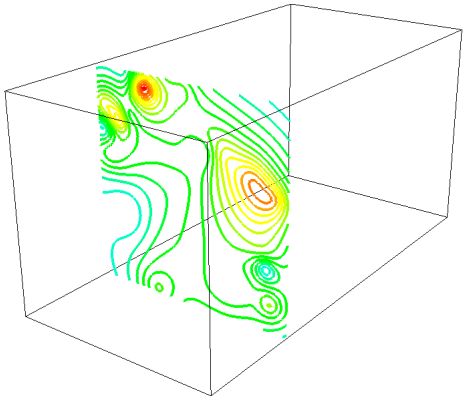


# Changing Operator Order



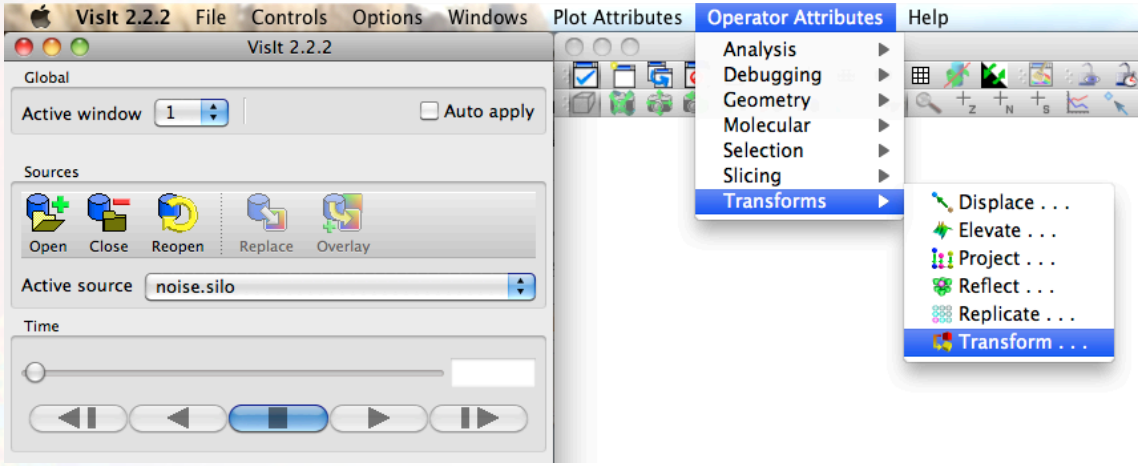



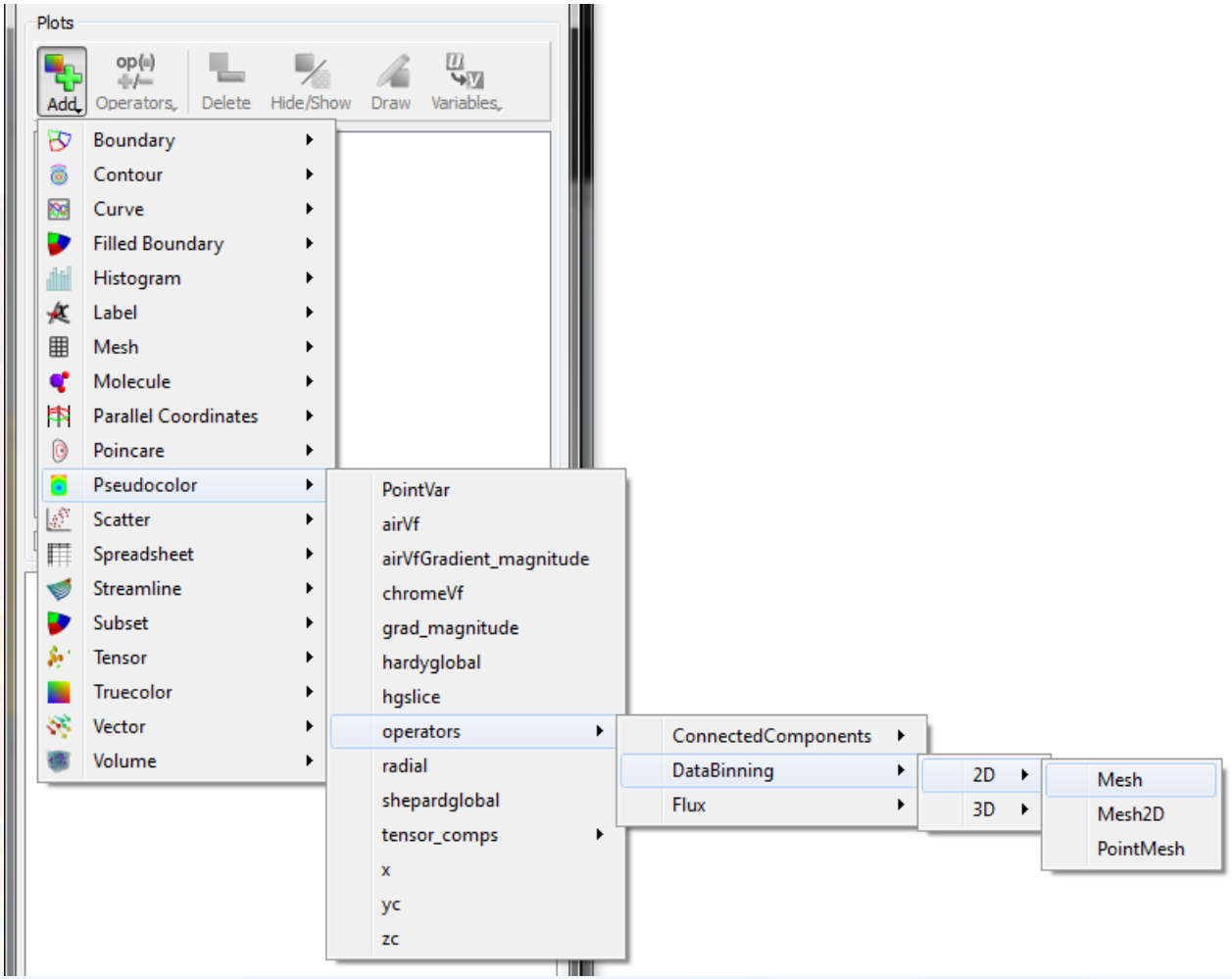


# Setting Operator Attributes

- The operator attributes menu provides buttons to activate the operator attribute windows
- Double-clicking on an operator in an expanded plot entry opens that operator's attributes window
- Each operator type has a single operator attribute window
- To change operator attributes:
  - Select the plots whose operators you want to modify or select a single operator from an expanded plot entry
  - Change some operator attributes



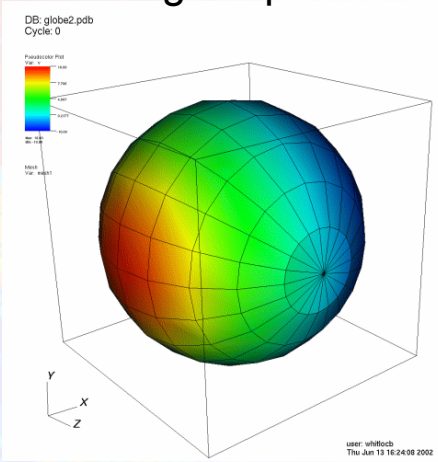
# Some Operators Create Variables



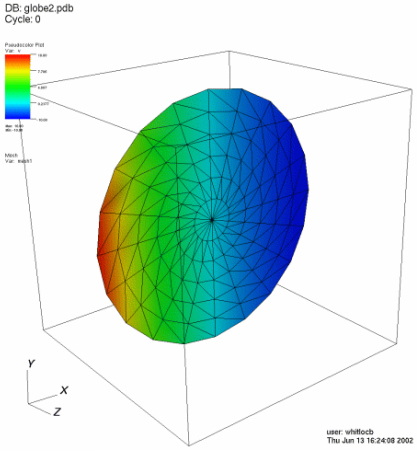
# Slice Operator

- The Slice operator slices 3D plots with a plane, which can have an arbitrary orientation or an axis-aligned orientation for orthogonal slices
- The resulting plots can remain in 3D space or they can be projected to 2D for further inspection
- Use this operator when you want to see the interior of 3D plots

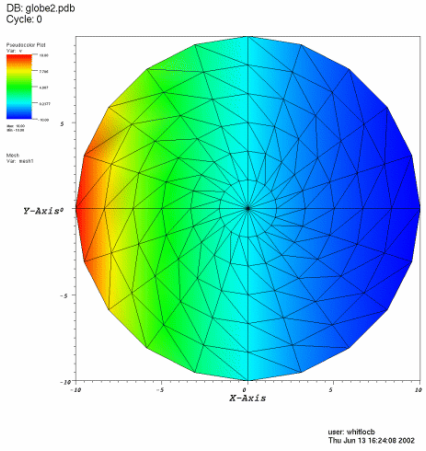
Original plots




2D plots in 3D space

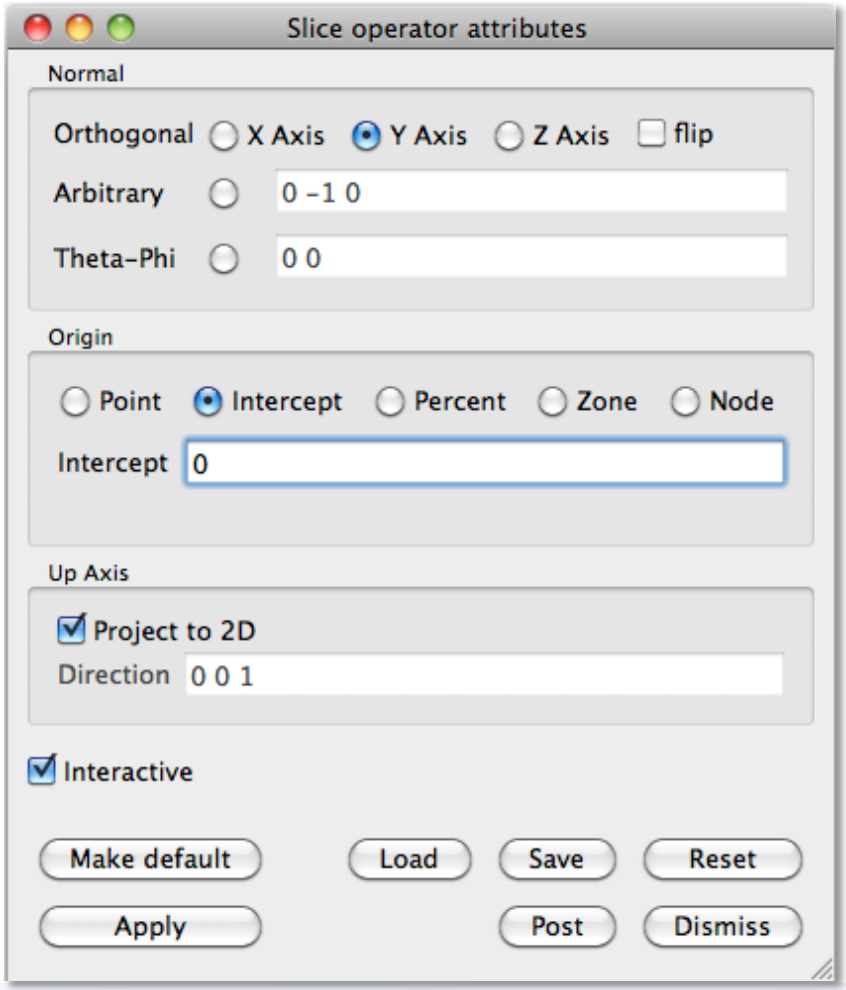



2D plots in 2D space

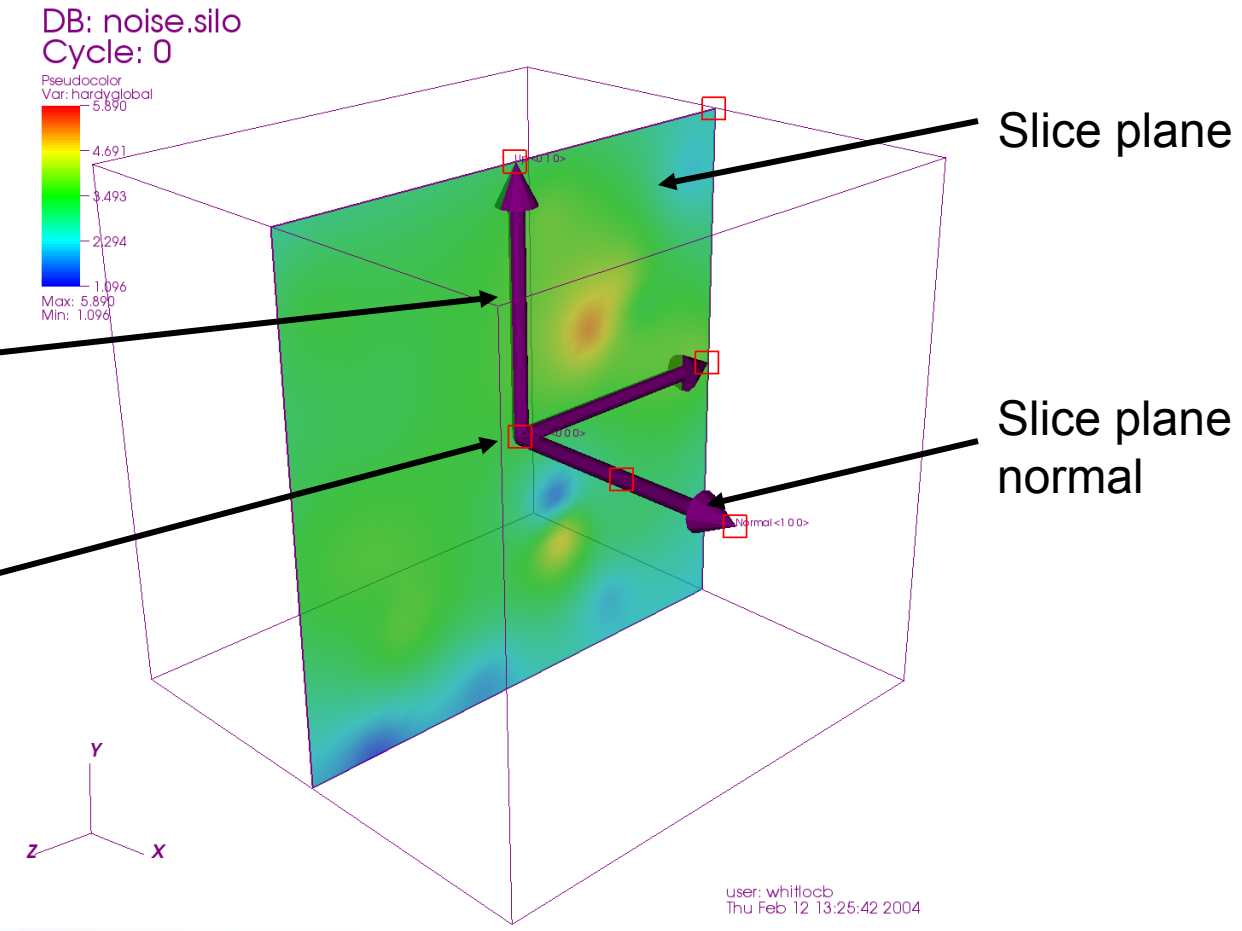


# Slice Operator Attributes

- Three pieces of information are required to specify the plane for the slice
  - Plane normal
    - Axis aligned
    - Arbitrary
  - Plane origin
    - Point
    - Intercept *(distance along normal axis)*
    - Percent *(percent through spatial extents along normal axis)*
    - Zone
    - Node
  - Up axis
    - Only used when projecting the slice to 2D



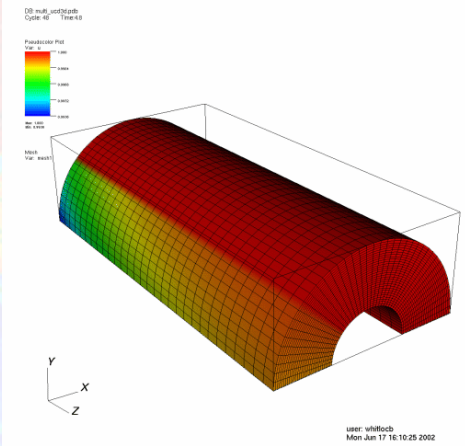
# Slice Plane


DB: noise.silo
Cycle: 0
Pseudocolor
Var: hardyglobal
5.890
4.691
3.493
2.294
1.096
Max: 5.890
Min: 1.096
Slice plane up axis
Slice plane origin
Slice plane
Slice plane normal
Y
Z
X
user: whitlocb
Thu Feb 12 13:25:42 2004

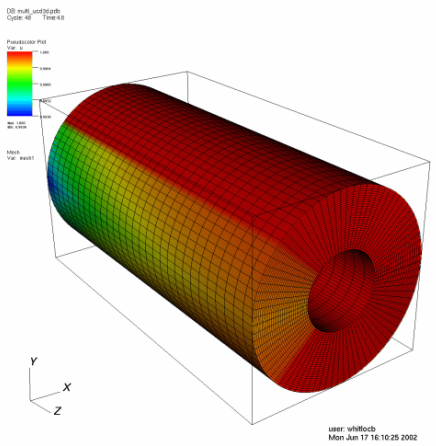
# Reflect Operator

- The Reflect operator reflects database geometry across one or more axes
- Use this operator when your simulation data contains only part of the geometry and relies on symmetry to recover the rest of the geometry

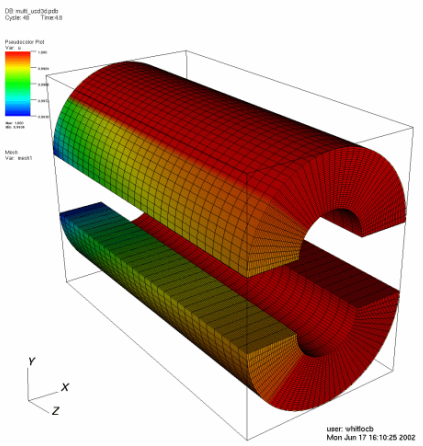
Original plots



Reflected plots



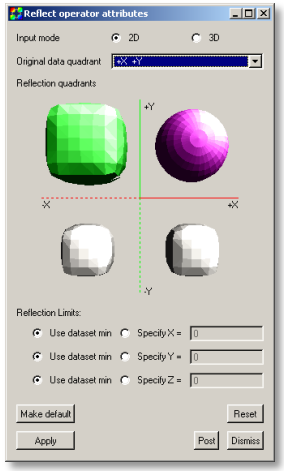
Reflected plots (different Y axis)



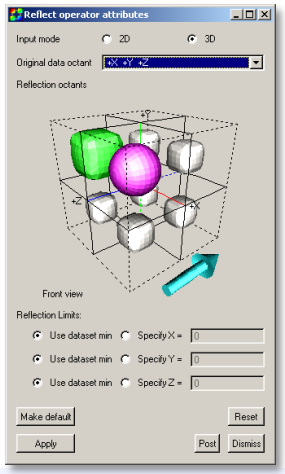
# Reflect Operator Attributes

- Reflect operator attributes window shows either 2D view of possible reflections or a 3D view of possible reflections
- Original data location
- Reflections
- Reflection limits

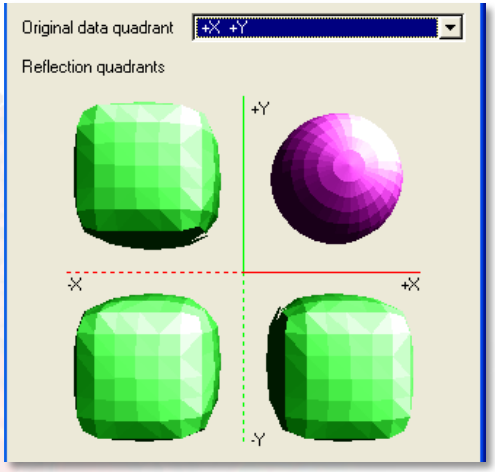
2D view of the Reflection operator attributes window

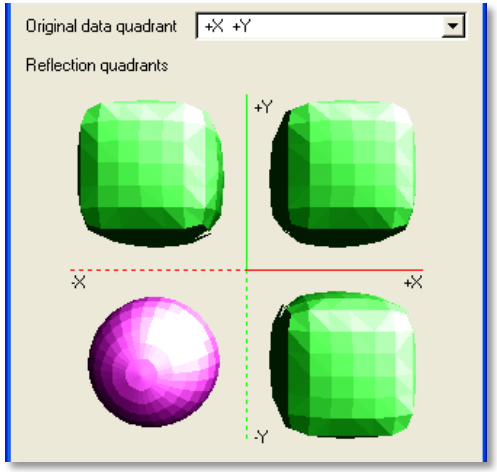


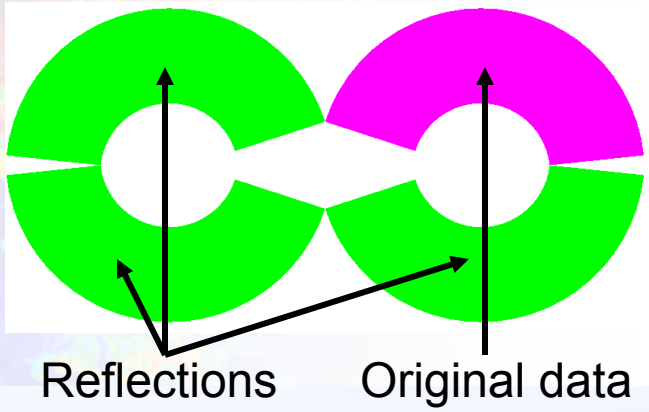

3D view of the Reflection operator attributes window

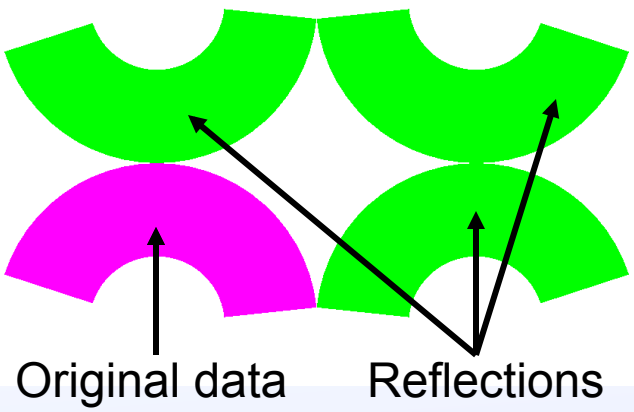


# Reflection Examples



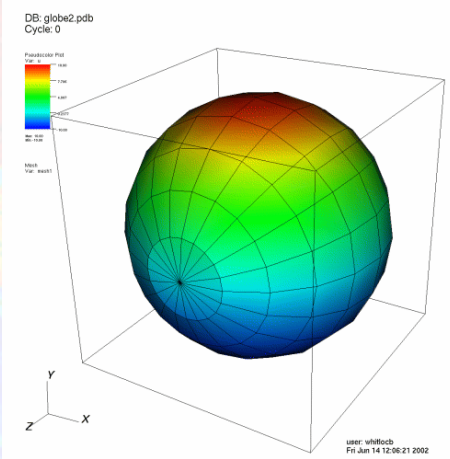



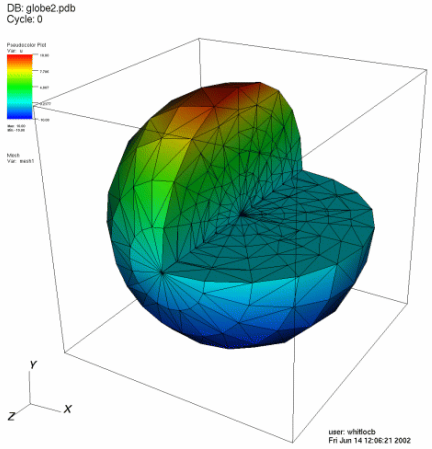
# Clip Operator

- The Clip operator clips 2D or 3D plots against planes or a sphere to remove sections of the plots
- Use this operator when you want to see a cross section of a 3D plot, while still leaving the plot in 3D

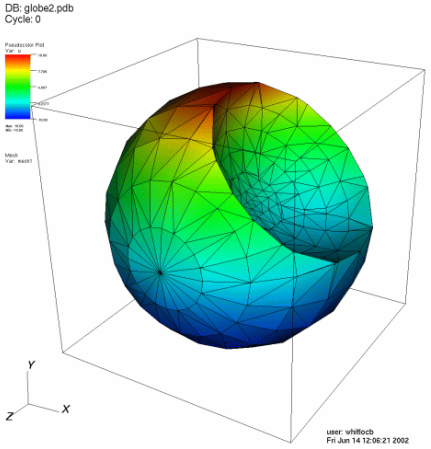
Original plots




Plots clipped with 2 planes

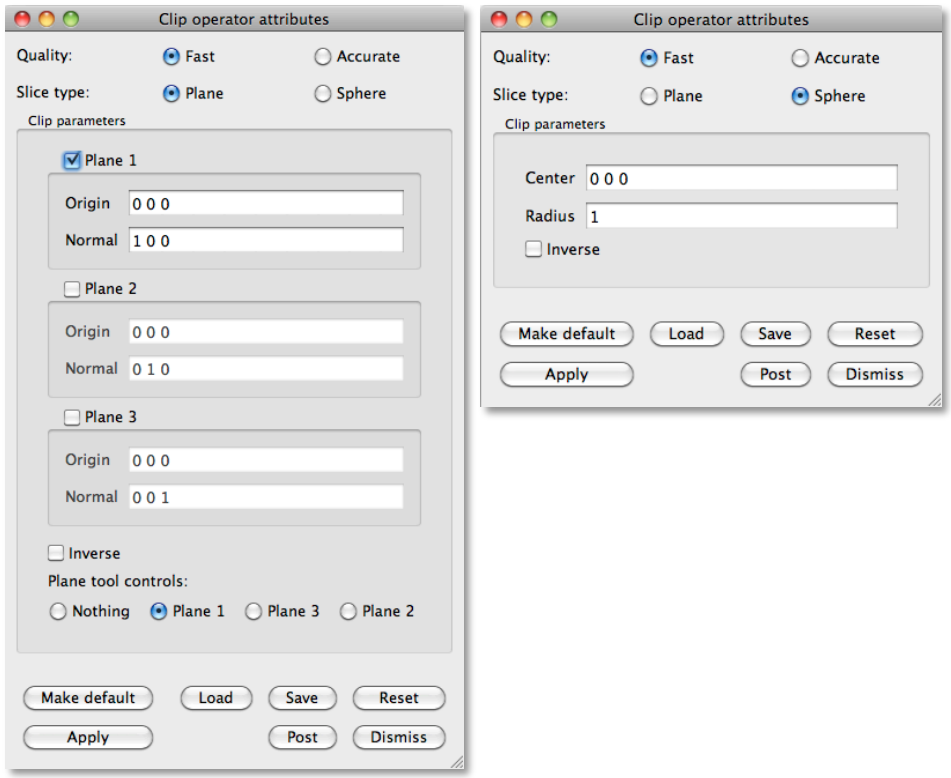



Plots clipped with a sphere



# Clip Operator Attributes

- Plane properties
  - Up to 3 planes can be used
  - Planes are specified using origin and normal
- Sphere properties
  - Sphere is specified using origin and radius



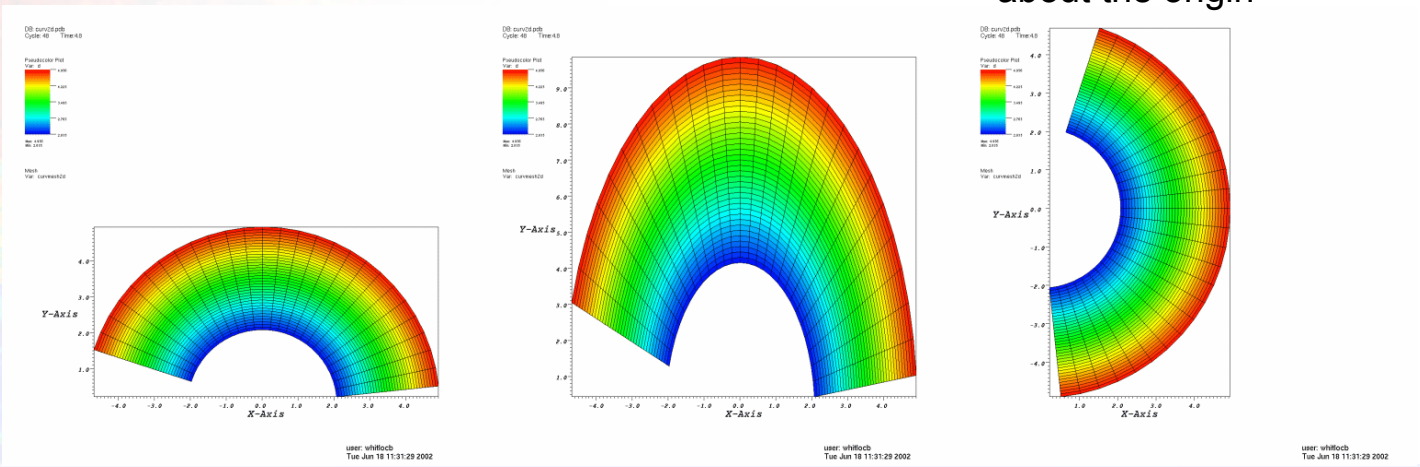
# Transform Operator

- This operator manipulates a 2D or 3D database's coordinate field by applying rotation, scaling, and translation transformations
- Use this operator when you want to scale, rotate, or translate a variable before it is plotted

Original plots

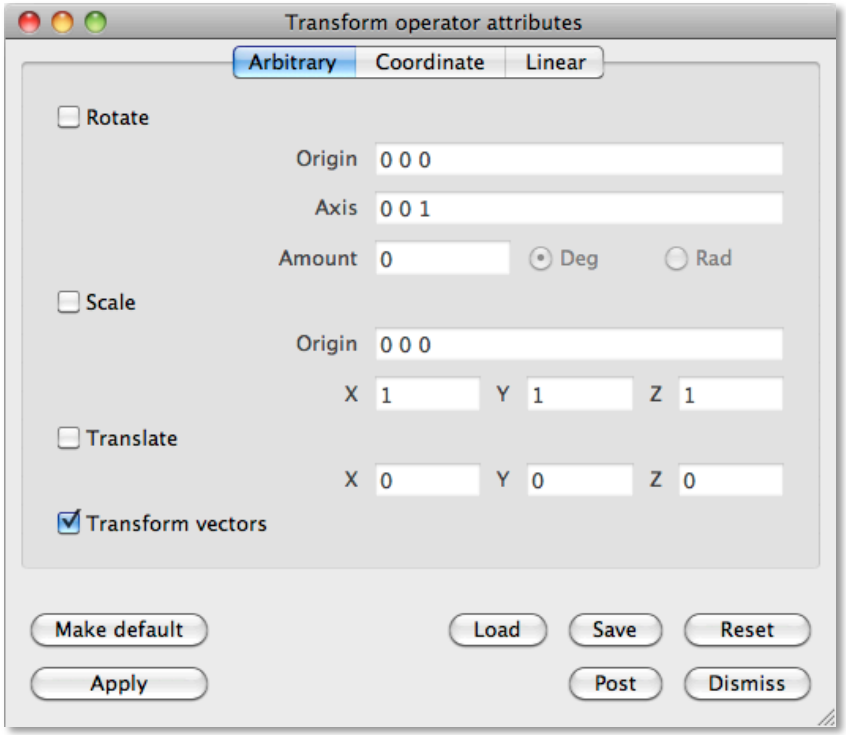
Scaled in Y dimension

Rotated -90 degrees about the origin



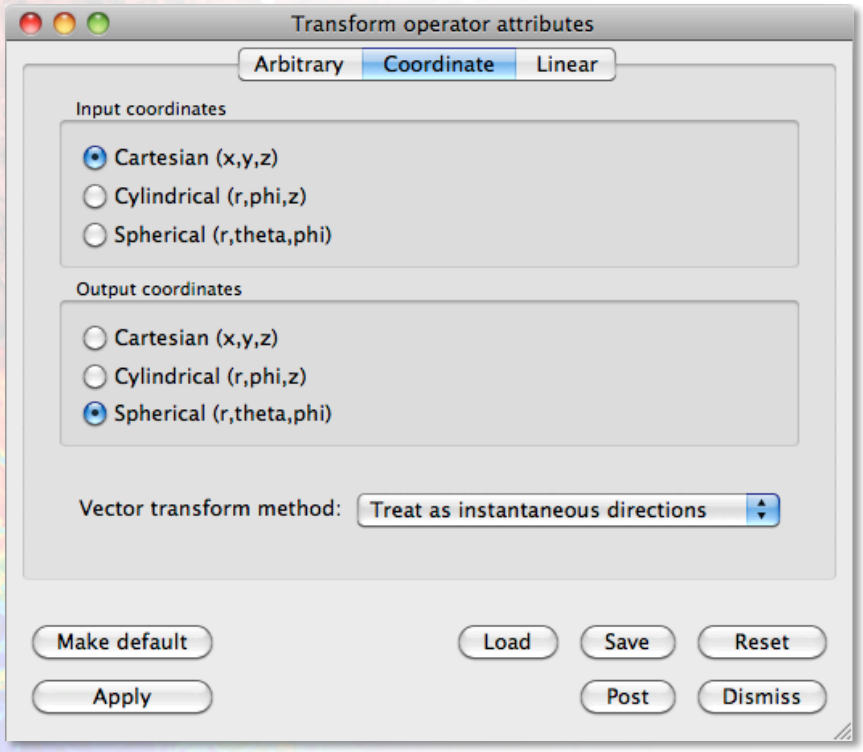
# Transform Operator Attributes

- Transformations are applied in this order:
  - Rotation
  - Scaling
  - Translation
- No translations are on by default
- Rotation is, by default, around the origin or the Z-axis in 3D
- Independent scaling of X, Y, Z coordinates
- Translation

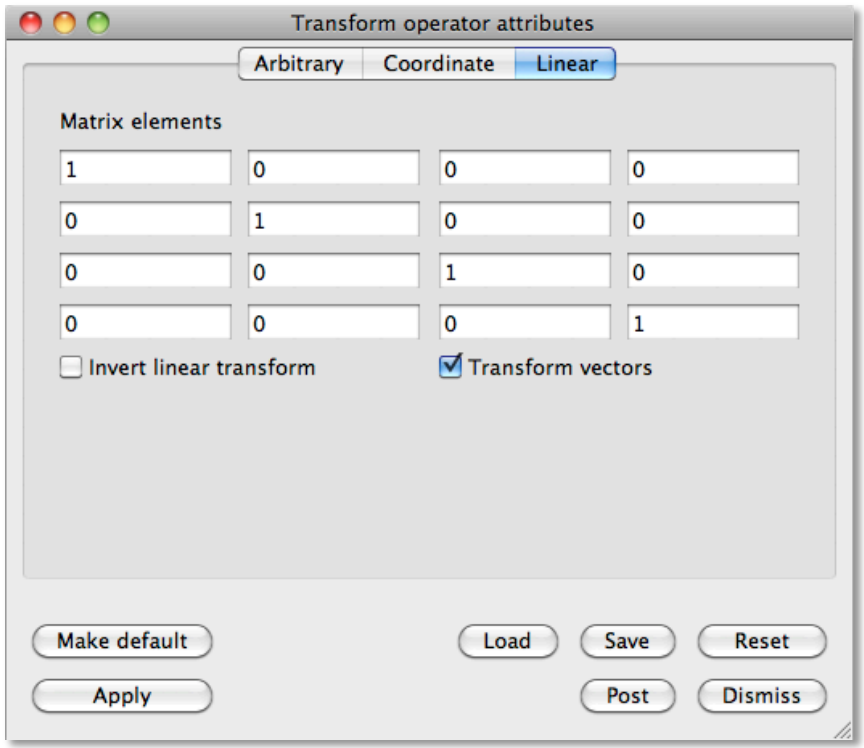


# Transform Operator Attributes

## Coordinate transforms



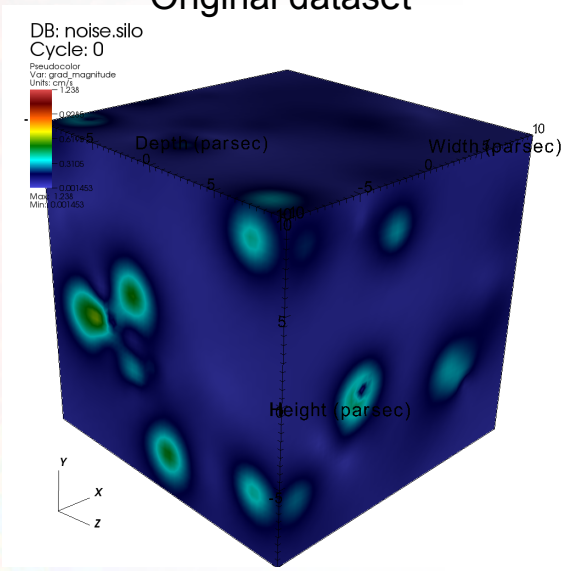

## Linear transform



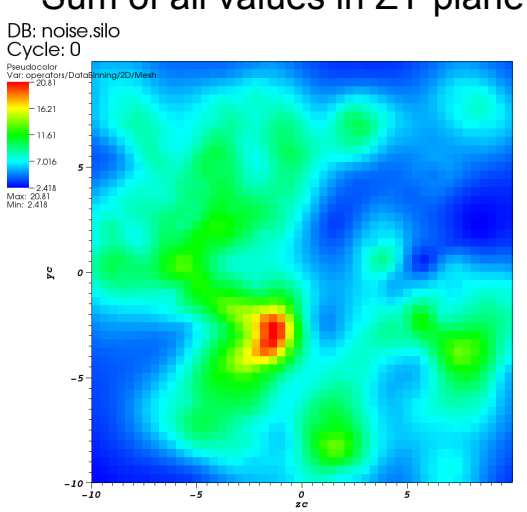
# Data Binning Operator

- The Data Binning operator lets you create multiple dimensional histograms and then apply reduction operations that produce a variable
- Use this operator when you are trying to extract statistics about the dataset

Original dataset

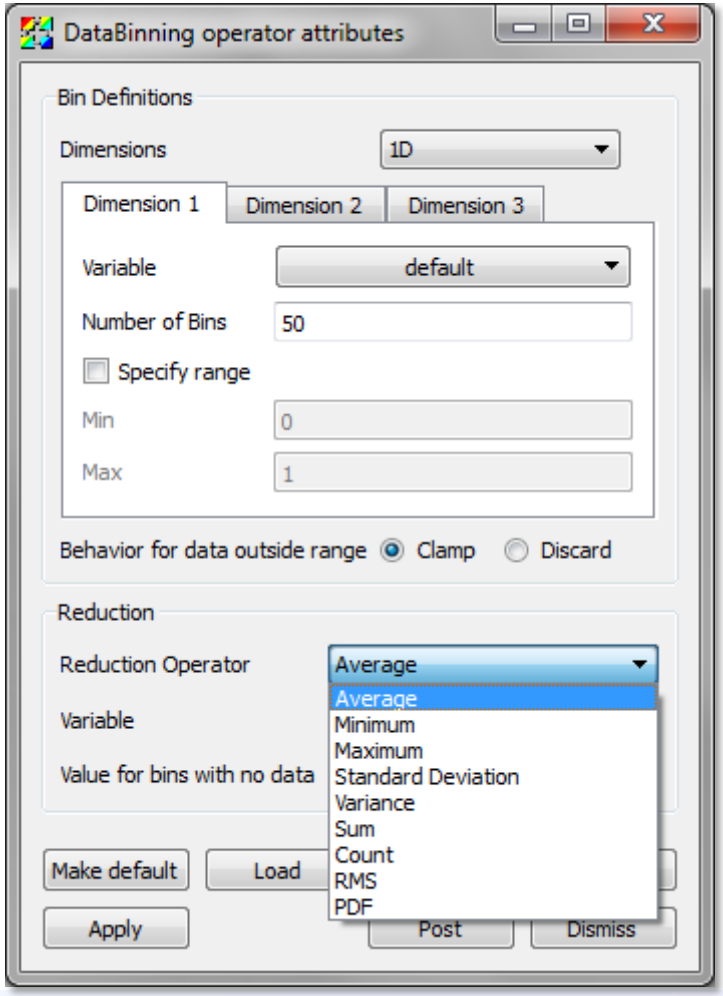



Sum of all values in ZY plane



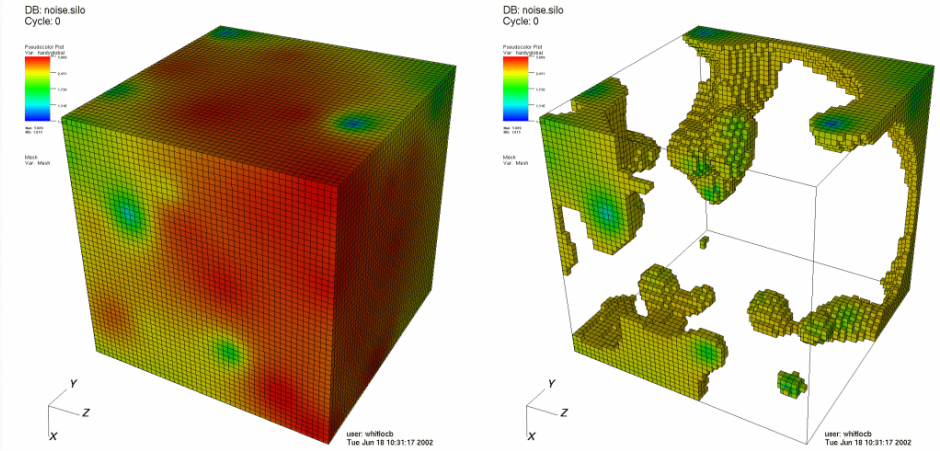
# Data Binning Operator Attributes

- Use up to 3 variables and bin them in each dimension
- Apply a reduction operation to the bins to produce the variable created by the operator



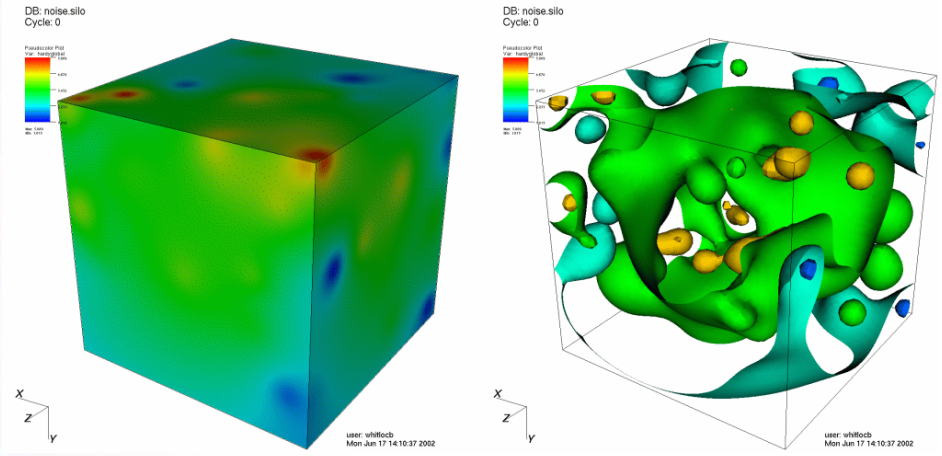
# Threshold Operator

- Removes cells whose value is not in the specified range
- Use this operator when you only want to look at cells that have values within an interesting range
- You can threshold based on several variables



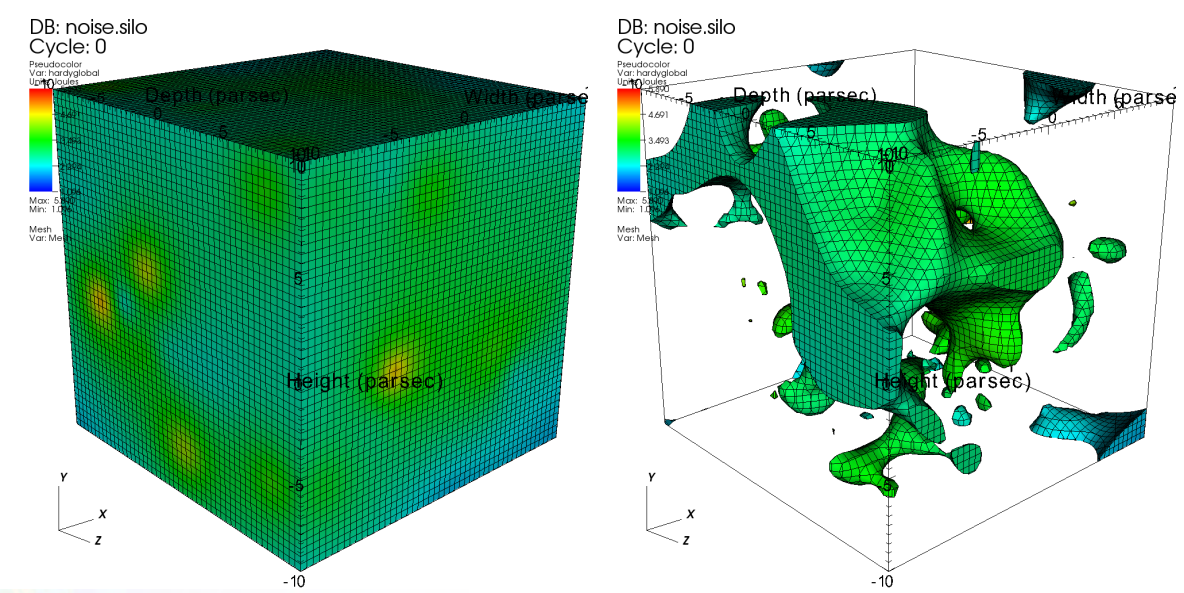
# Isosurface Operator

- This operator lets you “slice” another plot by the isosurfaces of another variable
- Use this operator when you want to plot one variable but only on certain contours of a secondary variable



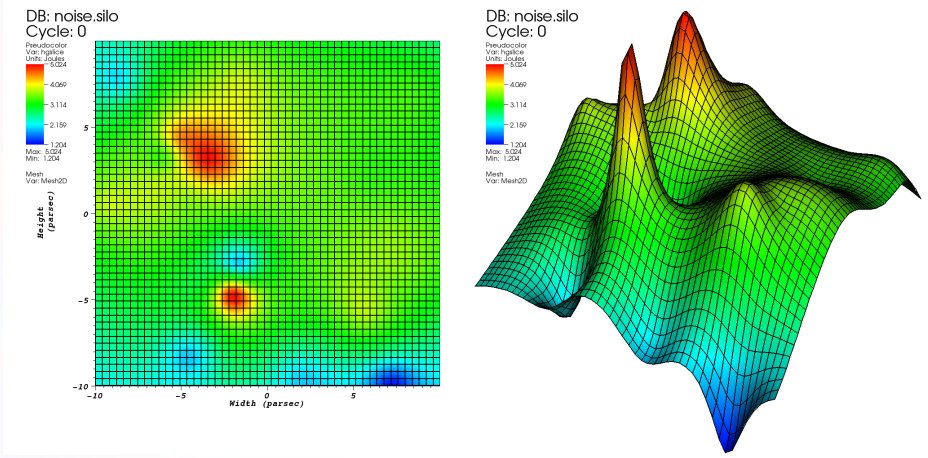
# Isovolume Operator

- This operator lets you clip another dataset using a range of values of a second variable, producing a volume
- Use this operator when you want to extract a volume enclosed by a range of values of a secondary variable



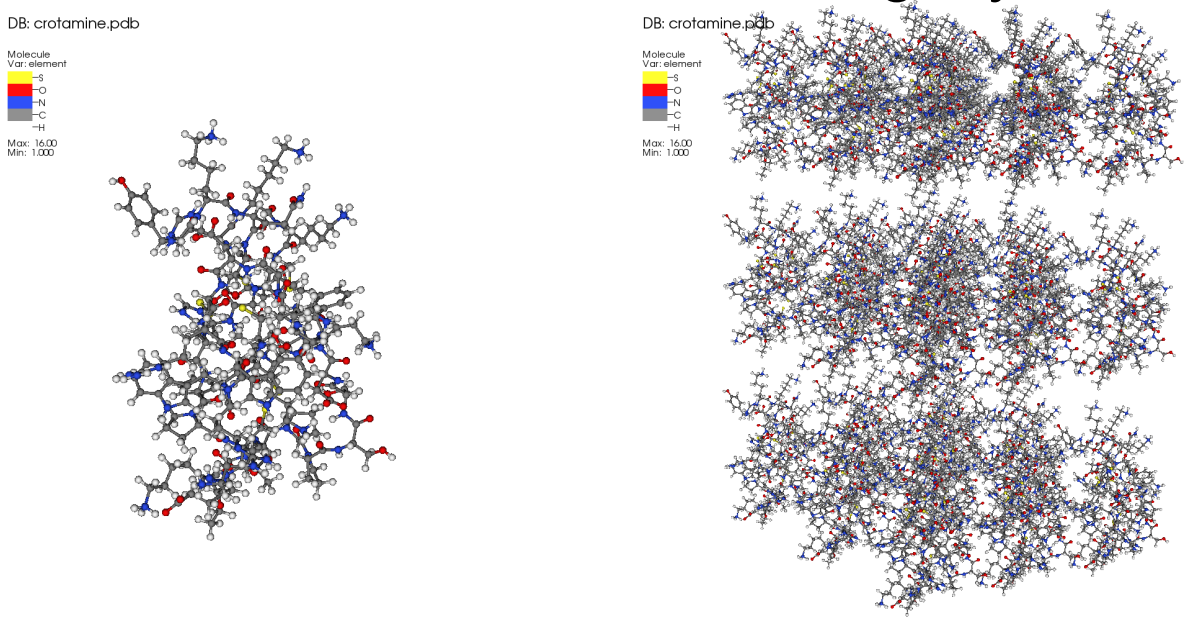
# Elevate Operator

- The Elevate operator displaces the surface of a 2D mesh using a scalar value, elevating it into a surface in 3D
- Use this operator when you want to view scalars as surfaces or when you want to elevate terrain by a height variable



# Replicate Operator

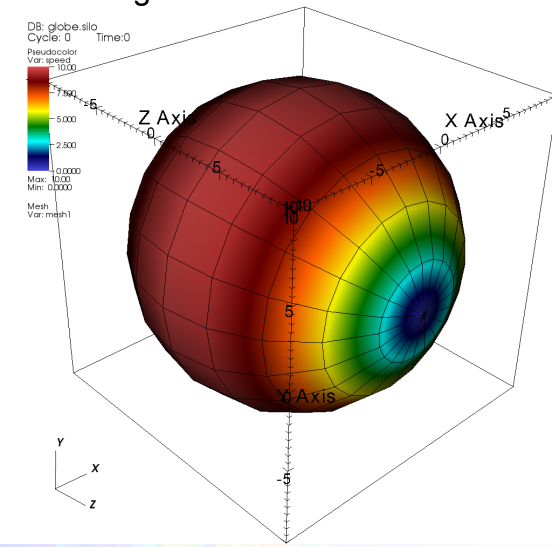
- The Replicate operator repeats an input dataset in each dimension
- Use this operator when you want to repeat a structure many times such as when assembling crystals



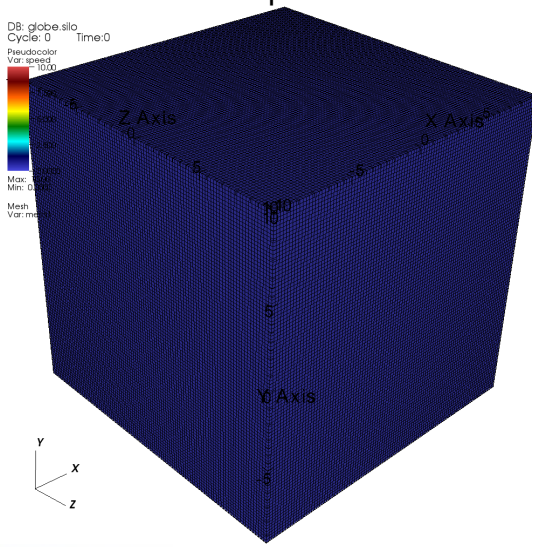
# Resample Operator

- The Resample operator samples data from its original geometry onto a rectilinear grid
- Use this operator when analysis on a rectilinear grid is desired

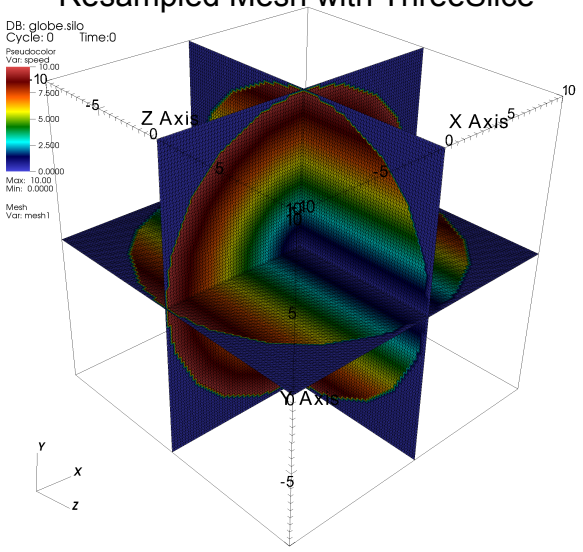
Original Unstructured Mesh



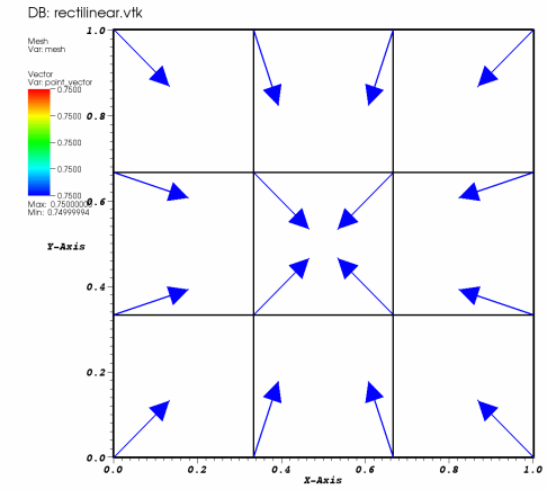

Resampled Mesh

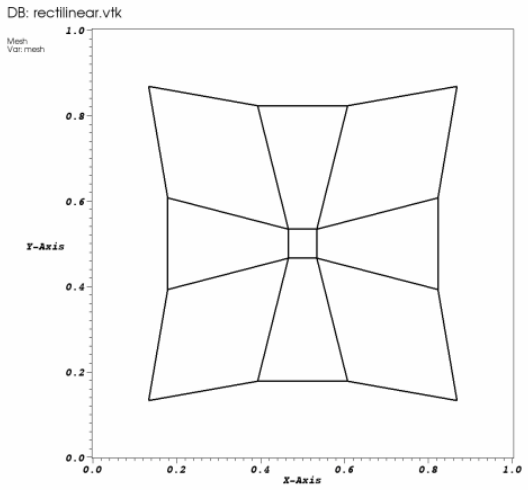


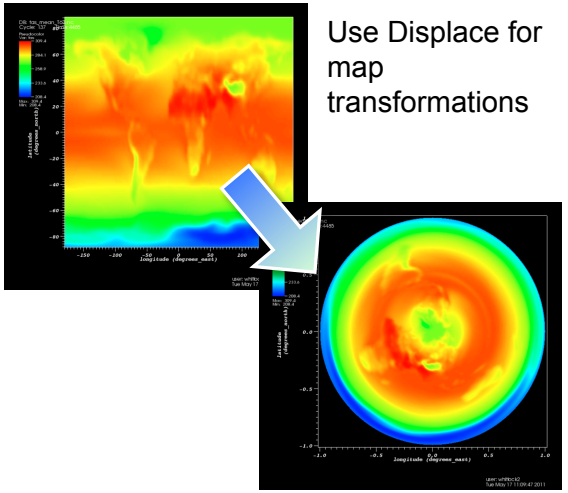

Resampled Mesh with ThreeSlice



# Displace Operator



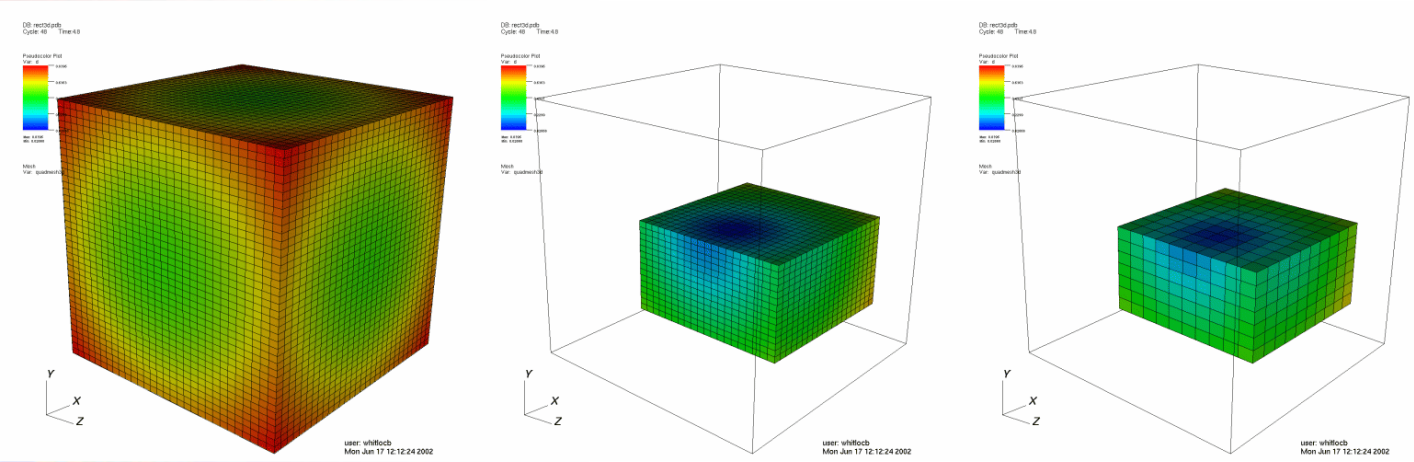



Use Displace for map transformations

- The Displace operator adds a vector variable to the coordinates of the input mesh, displacing it
- The Displace operator is useful for warping meshes
  - Some file formats save displacement vectors to move parts as time progresses (Exodus)
  - Use Displace to implement map transformations

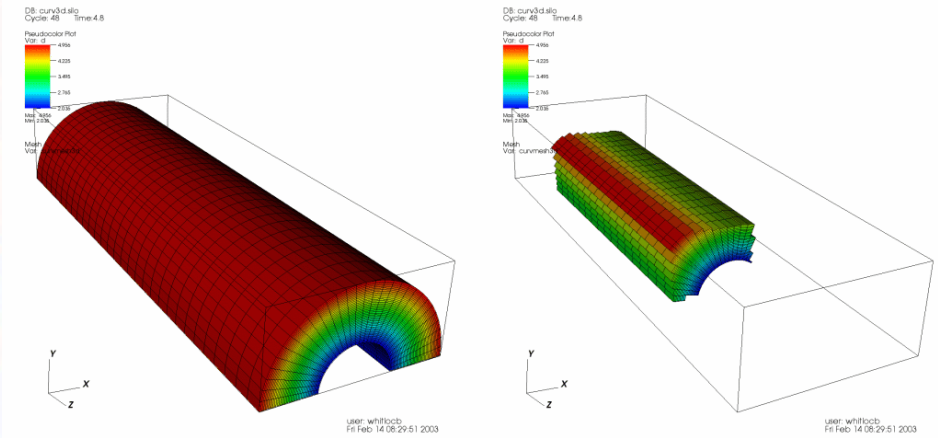
# Index Select Operator

- The Index select operator picks out a brick of cells from a structured mesh database using ranges of cell indices
- Use this operator when you want to pick out a brick of related cells or when you want to create a lower resolution version of a structured mesh database



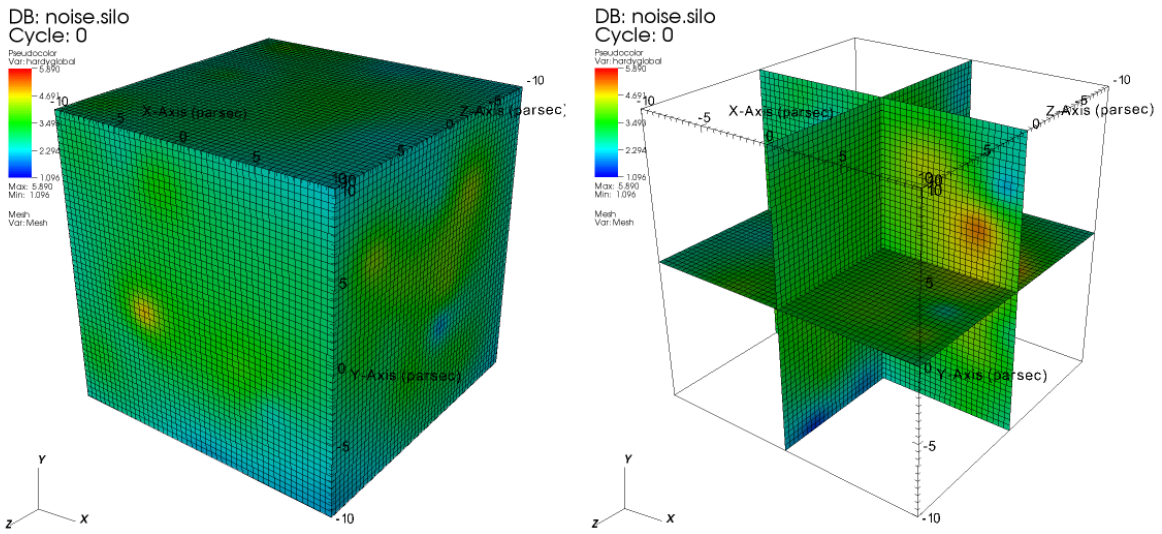
# Box Operator

- This operator removes cells that are outside of an axis-aligned box
- Use this operator when you want to remove cells that are outside of a given rectangular volume



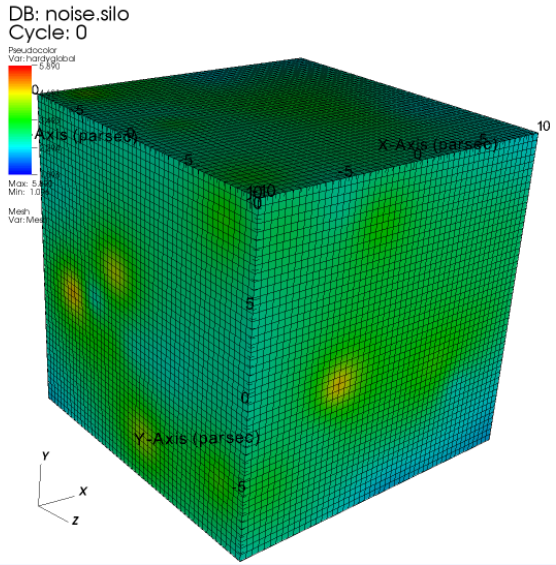
# Three Slice Operator

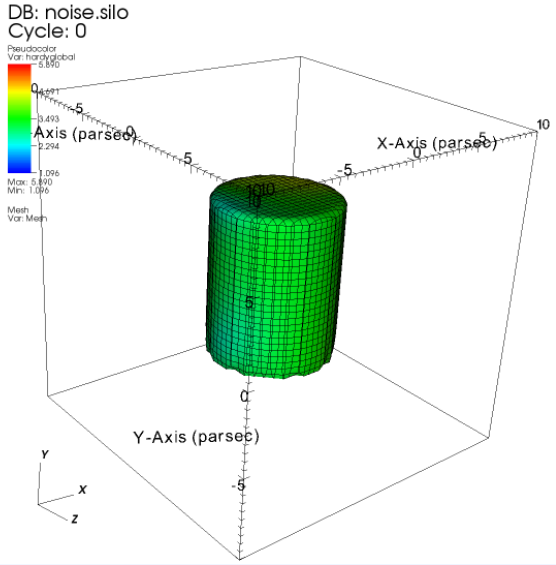
- This operator slices plots using three axis-aligned slice planes
- Use this operator when you want to see into the interior of 3D plots



# Cylinder Operator

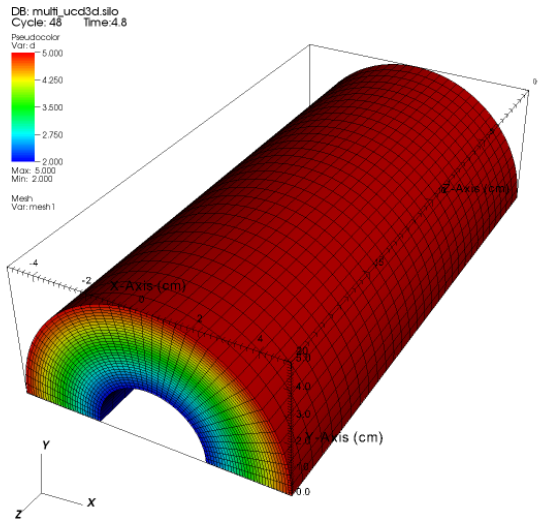
- This operator clips plots against a cylinder and returns an unstructured mesh
- Use this mesh if you want to see how data looks when clipped against a cylinder

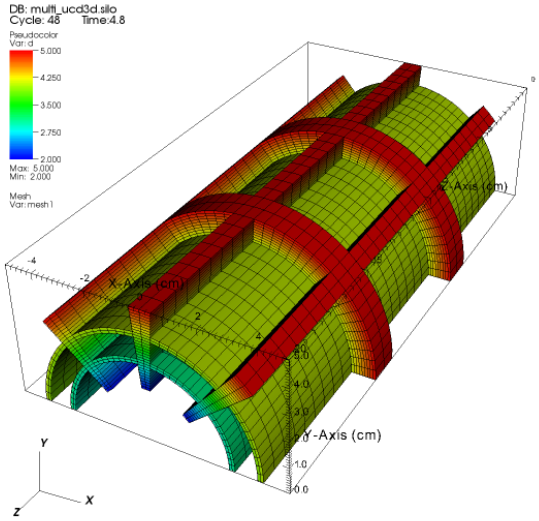


# Inverse Ghost Zone Operator

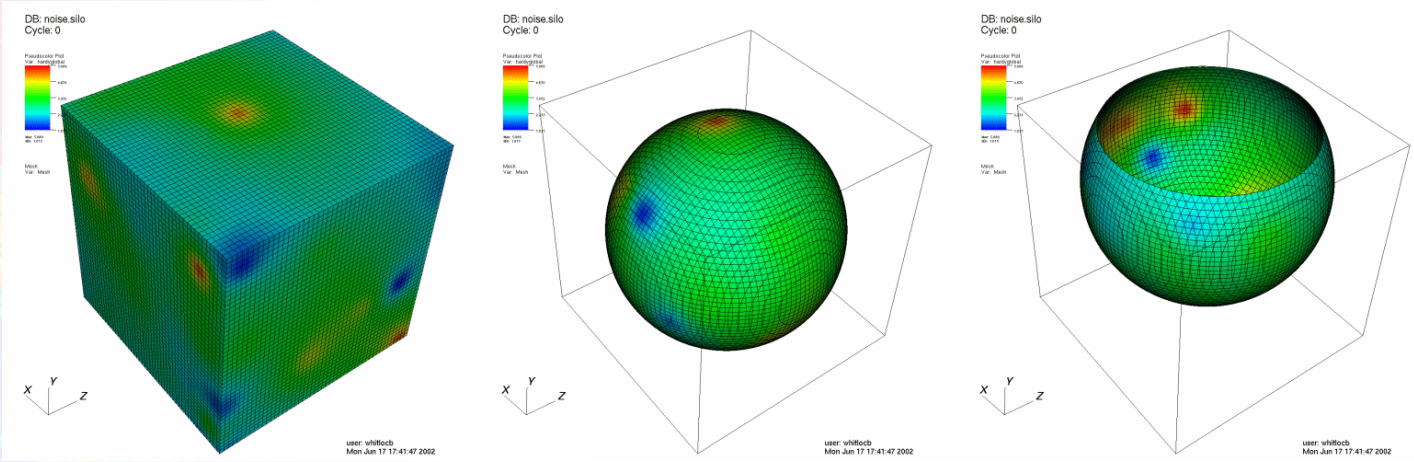
- This operator makes ghost zones visible and real zones invisible
- Use this operator when you want to look at your database's ghost zones



# Spherical Slice Operator

- This operator slices plots with a sphere and returns the surface of the sphere
- Use this operator when you want to test spherical symmetry

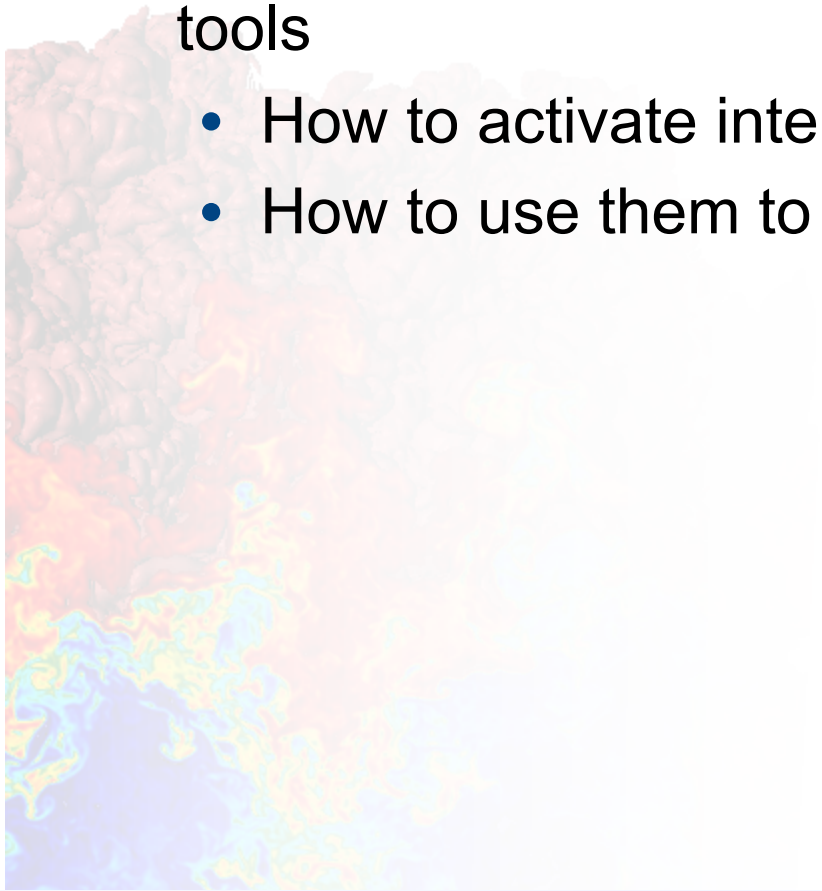


# Exercise Group 5

# Interactive Tools

# Lesson Goals

- In this lesson, you will learn about VisIt's interactive tools
  - How to activate interactive tools
  - How to use them to set operator and plot attributes

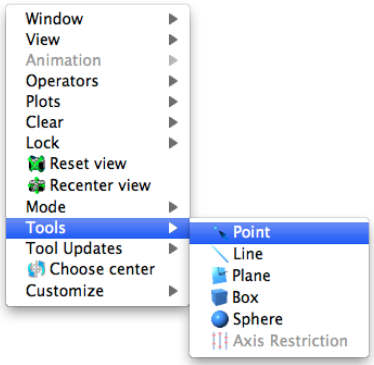


# Interactive Tools

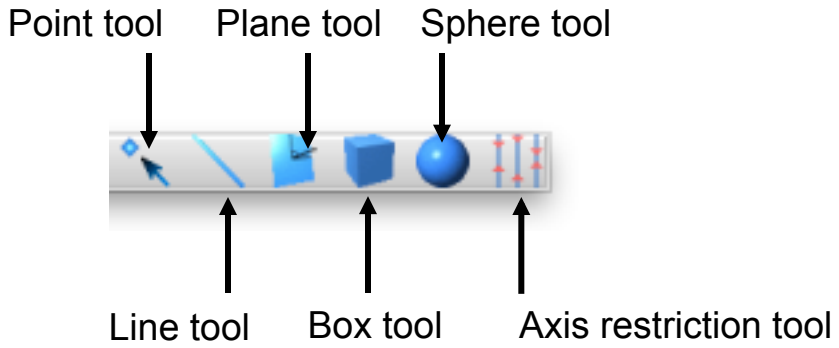
- Interactive tool
  - A visible object that can be added to a vis window
  - Has hot points that let you manipulate the tool
  - Can set attributes for certain plots and operators
  - Enabled via the Tools menu or the vis window's Popup menu
  - Some tools prefer to operate in vis windows that contain plots of certain dimensions
  - Some tools are not always available

# Activating Tools

Tool menu



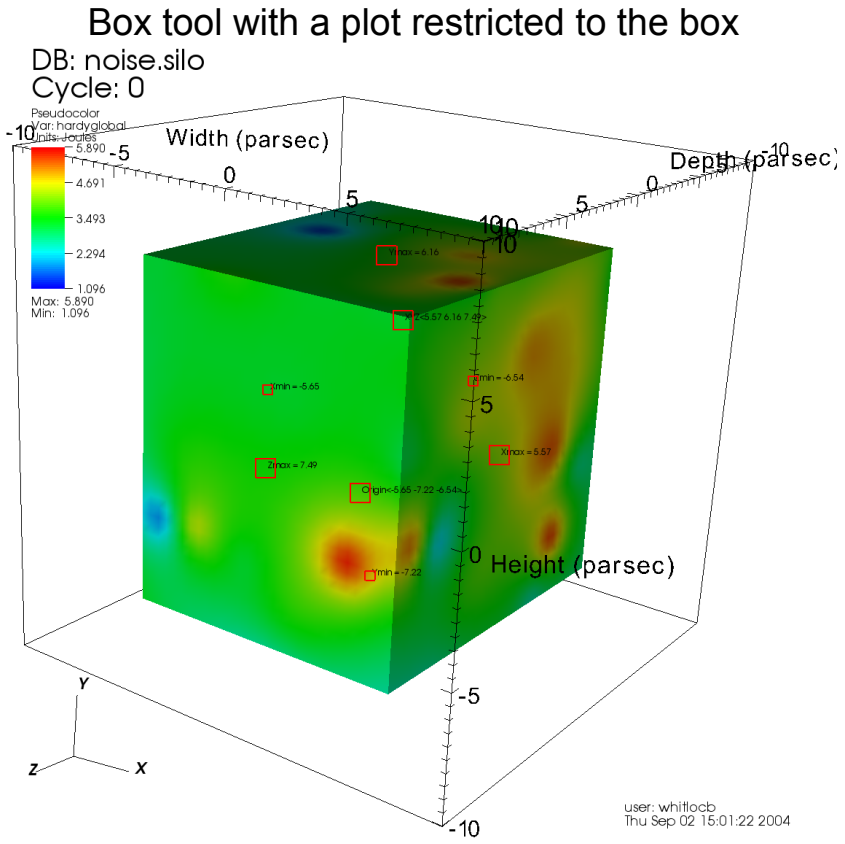

Tool toolbar




- Tools menu that lists all of VisIt's interactive tools
- To activate an available tool, select it from the Tools menu or click its icon on the Toolbar
- To deactivate a tool, choose the tool you want to deactivate from the View Menu or View Toolbar

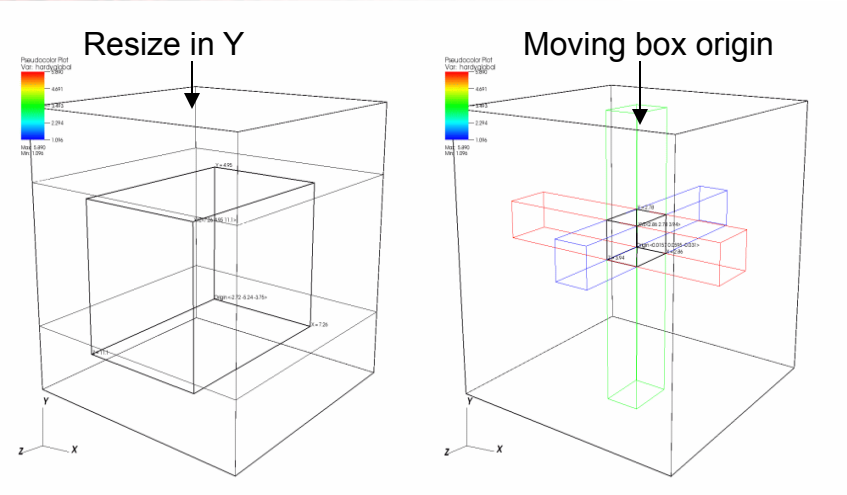
# Box Tool

- This tool allows you to move an axis-aligned box around in 3D space
- The Box tool allows you to move the box or resize it in any or all dimensions
- Each face of the box has a hotpoint that extends the box in the direction pointed to by the box face



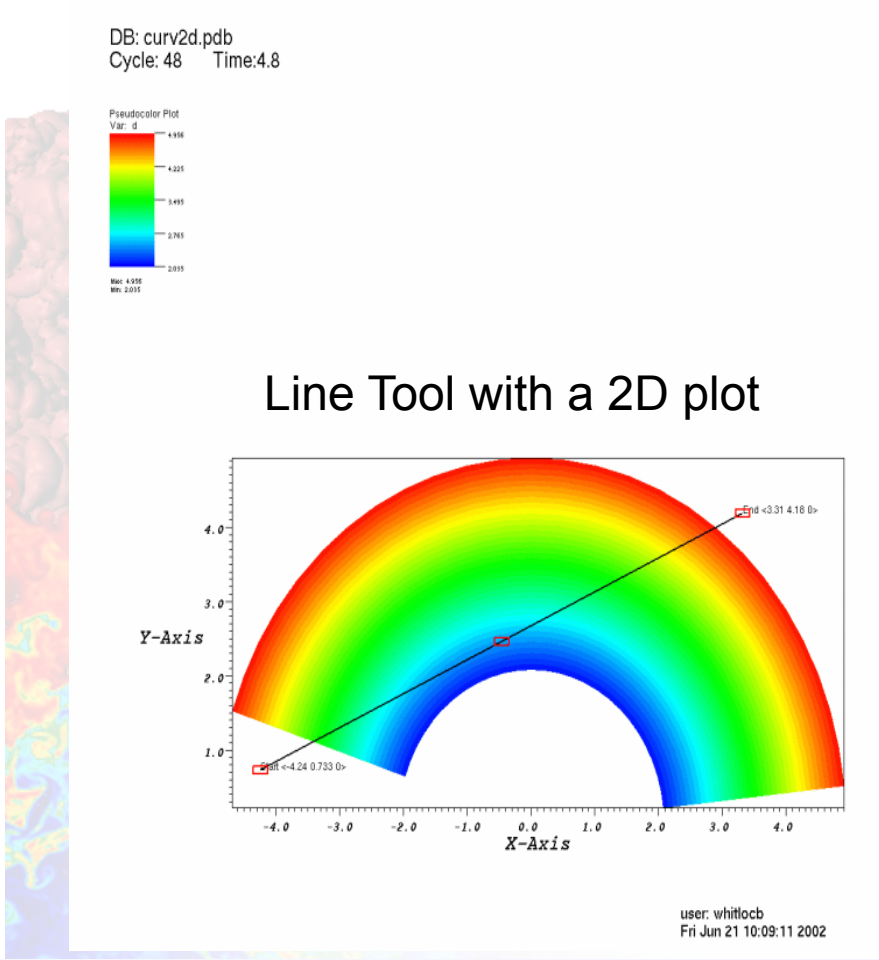
# More about the Box Tool…

Box tool appearance while it is resized or moved




- Reference planes appear when resizing the box in one dimension
- Moving box origin causes reference boxes to be drawn
- Holding shift key when moving origin constrains movement to the axis that most faces camera
- Used to set attributes for
  - Box operator
  - Streamline plot with box source

# Line Tool

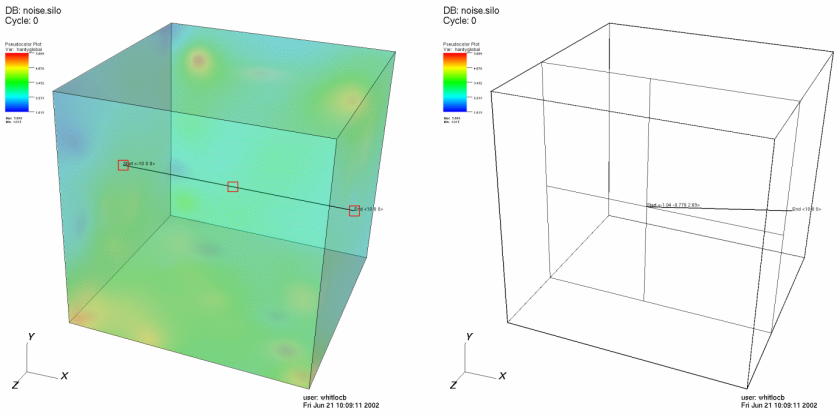



- The line tool is drawn as a thick line with 3 hot points along the line
  - Hot points on the ends move line end points
  - Middle hot point translates whole line
- Move reference lines after they are initially drawn
- Use to set attributes for
  - Lineout operator
  - Cylinder operator

# More about Line Tool…

- Line tool can be used for both 2D and 3D databases
- 2D line endpoints can only be moved in the X-Y plane
- 3D line endpoints can be moved in any direction
- Hold down Shift to move the line in the axis that most faces the camera
- Hold down Ctrl to extend the length of the line

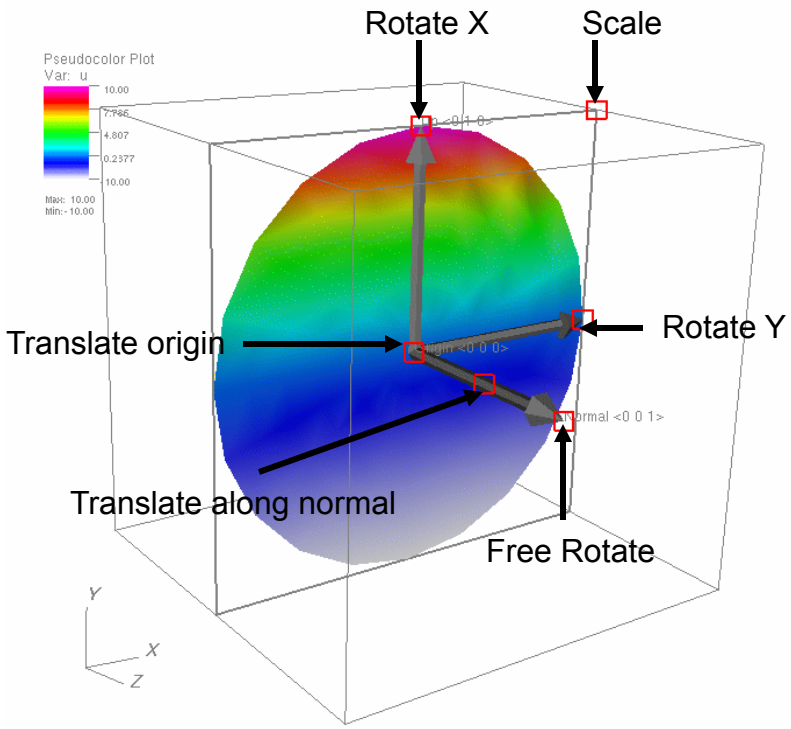
Line tool in 3D



# Plane Tool

- This tool allows the user to see a representation of a slice plane in a visualization window and position the plane relative to plots that may exist in the window
- You can use the plane tool to set attributes for certain VisIt plots and operators
  - Streamline plot with plane source
  - Slice operator

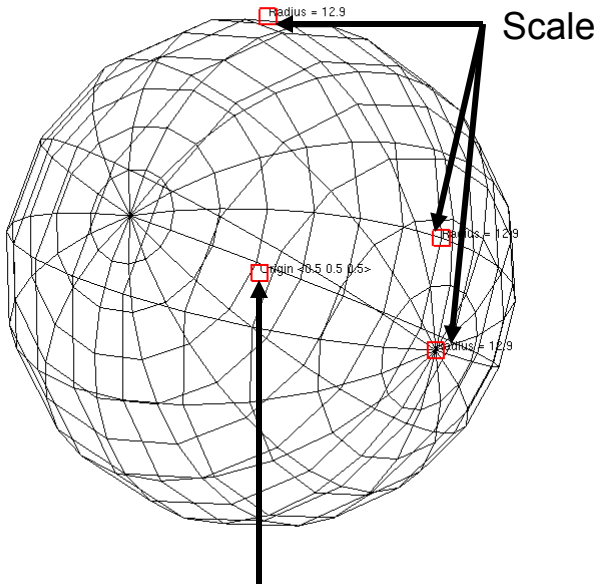
Plane Tool with sliced plot



# Sphere Tool

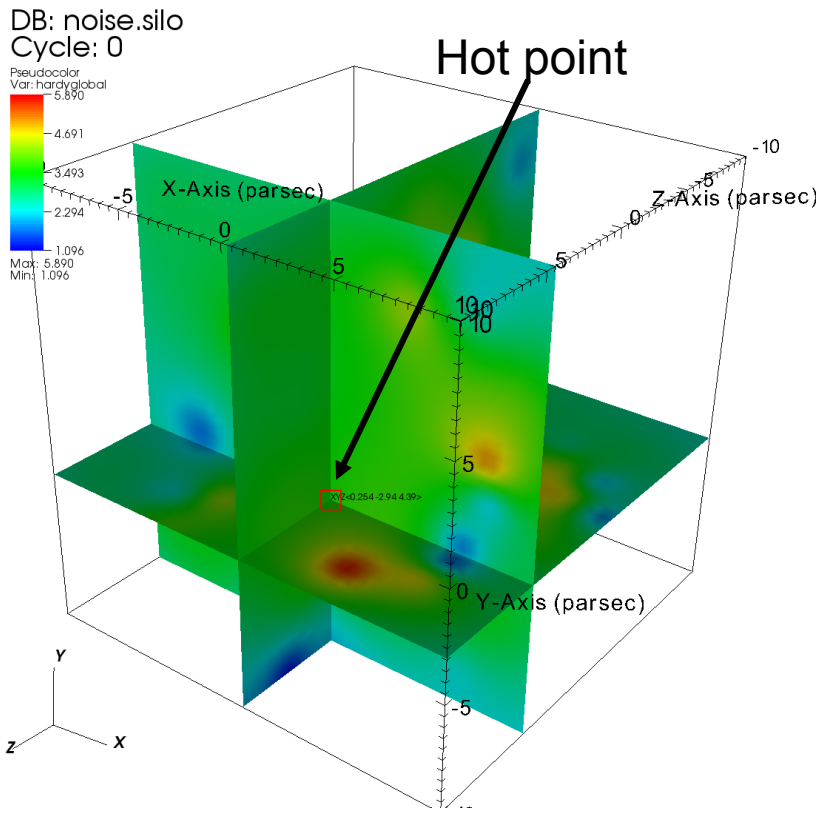
- This tool allows you to position a sphere relative to plots that exist in the vis window
- Several hot points are used to position and scale the sphere.
- This tool can be used to set attributes for certain VisIt plots and operators
  - Streamline plot with sphere source
  - Sphere slice operator
  - Clip operator when clipping with sphere

Sphere Tool



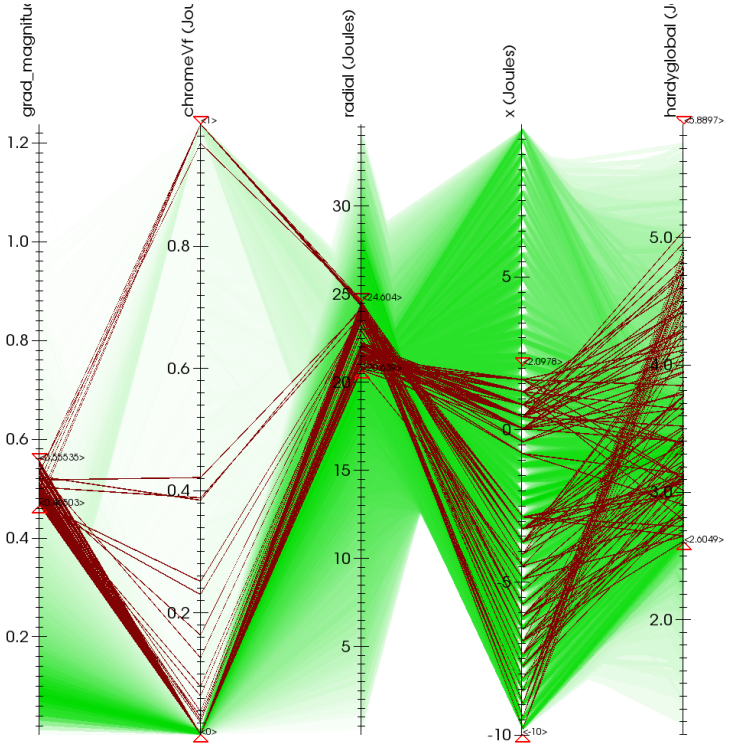
# Point Tool

- This tool allows you to position a point relative to other plots in the vis window
- This tool is used to set attributes for
  - Streamline plot with point source
  - ThreeSlice operator
- Hold Shift key to move point along axis most facing camera
- Hold Ctrl to move the point up an down in a plane
- Hold Ctrl and Shift to move the point left or right in a plane



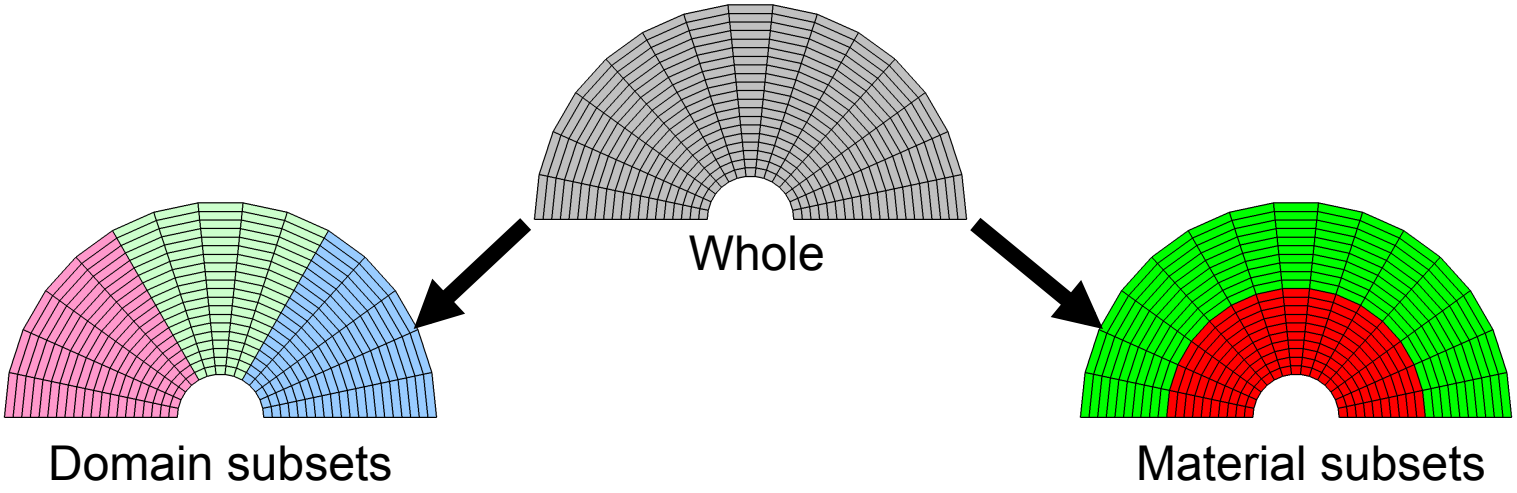
# Axis Restriction Tool

- This tool provides a set of upper and lower hot points for the axes used in the Parallel Coordinates plot
- You can use the tool's hot points to set minimum and maximum ranges to restrict values used in Parallel Coordinates' focus



# Exercise Group 6

# Subsets

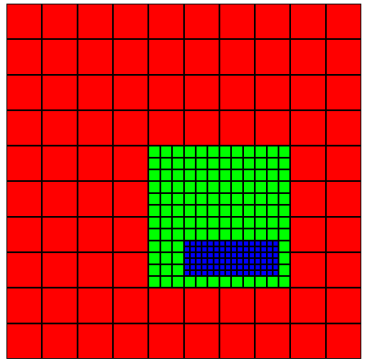


# Lesson Goals

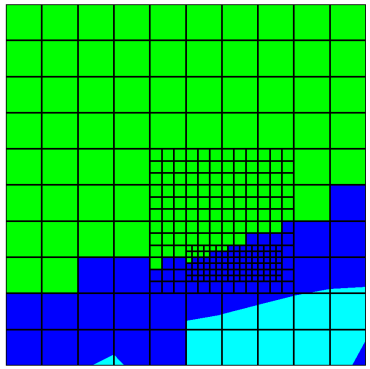
- In this lesson, you will learn how VisIt uses subsets and the Subset Inclusion Lattice to manage what portions of a database are used in a visualization
- You will also learn about VisIt's Subset window and when and how you can use it to remove subsets from plots

# What is a Subset?

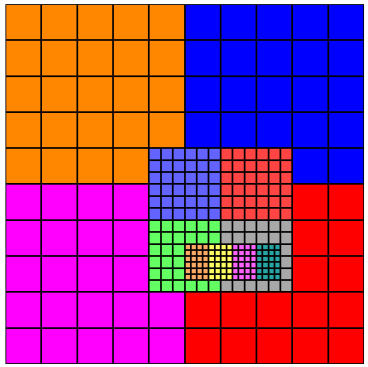
- Many scientific databases are decomposed in various arbitrary ways into smaller pieces called subsets that, when combined, make up the whole



Level subsets



Material subsets

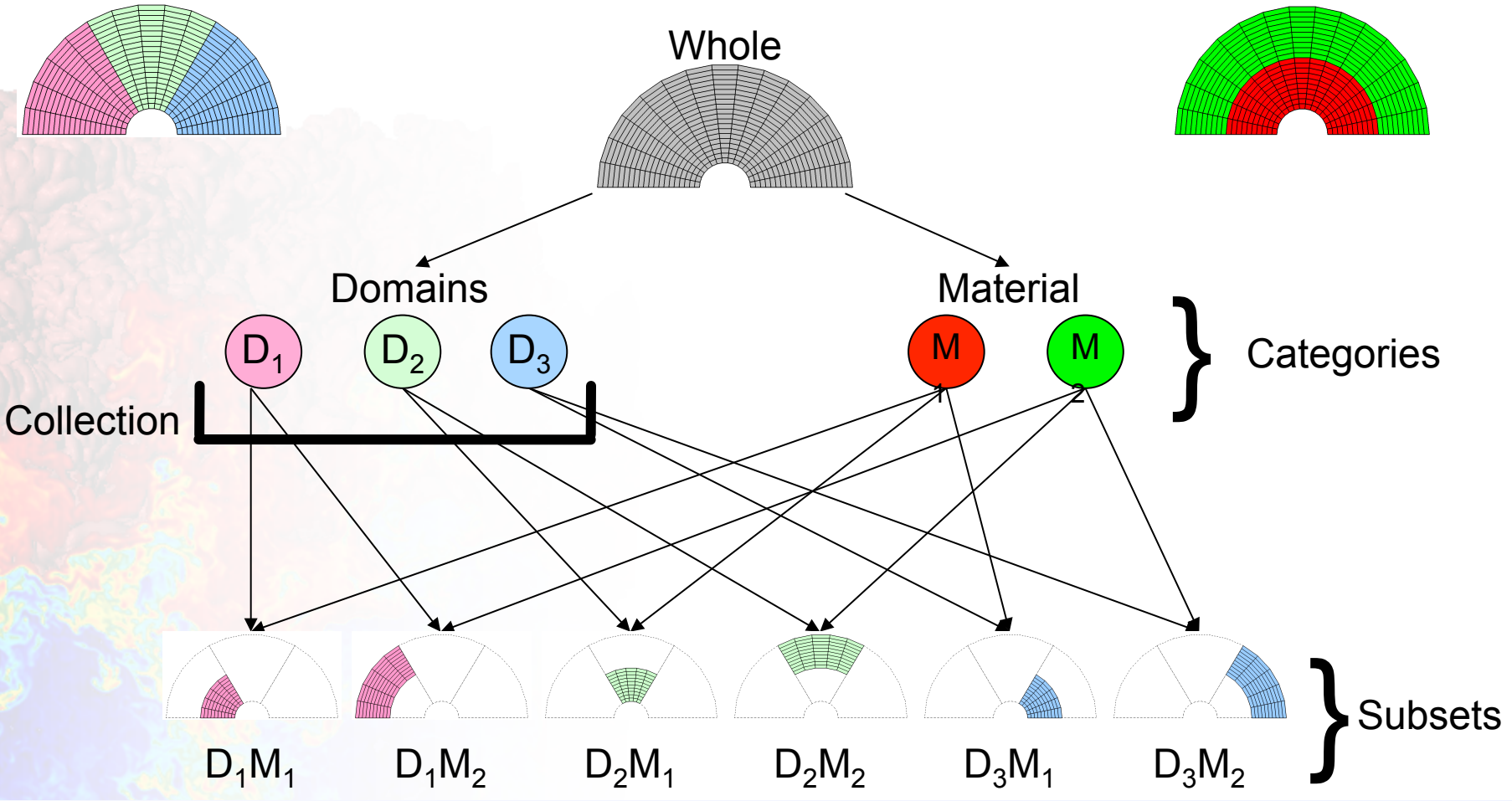


Patch subsets

# How Are Subsets Represented?

- VisIt creates a Subset Inclusion Lattice (SIL) that describes how the cells in the database are related
- Cells are grouped into sets
- Relations between sets are called categories
- Categories can be arbitrarily defined by the database format
- Common categories
  - Domains
  - Materials
  - Patches
  - Levels

# What Does a SIL Look Like?

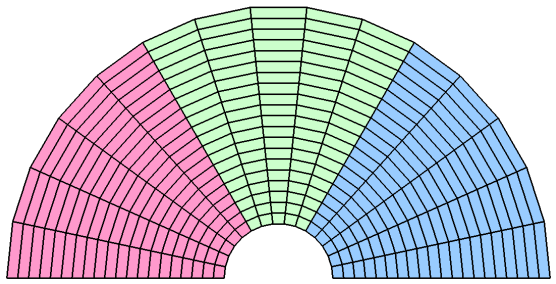


# How is a SIL Used?

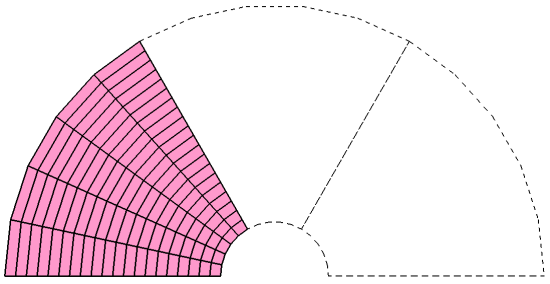
- VisIt uses a SIL to restrict the data on which it operates and to remove sets from the visualization
- You can remove set  from any category to create complex SIL restrictions

# Domain Selection

- Domain selection is when you turn off subsets that are members of the Domains collection
- Why would you want to turn off domains?
  - Fewer domains can mean much less processing needs to be done. VisIt will run faster!
  - You might be interested in a cell in a given domain and you only want to plot that domain

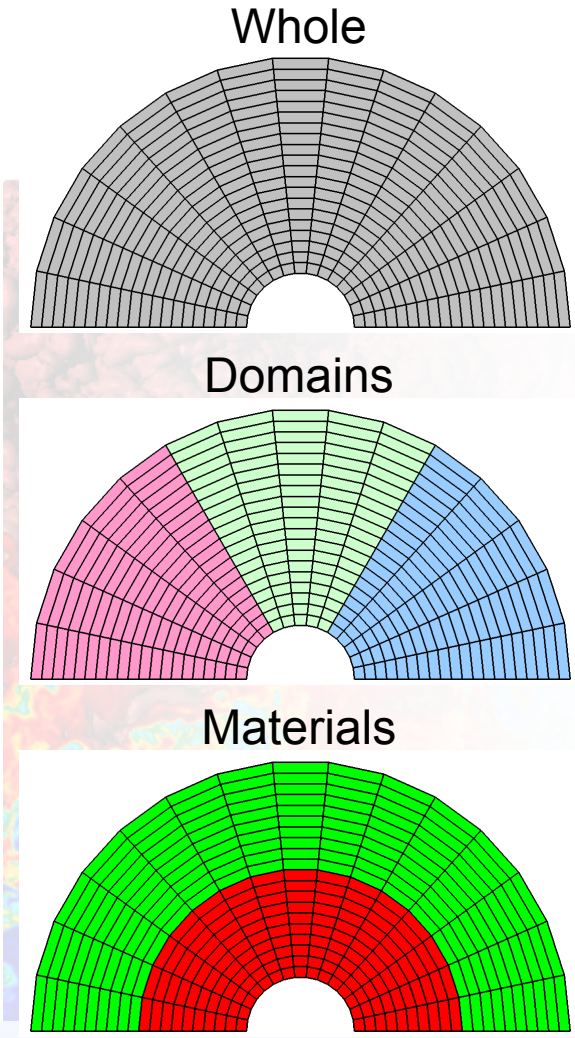


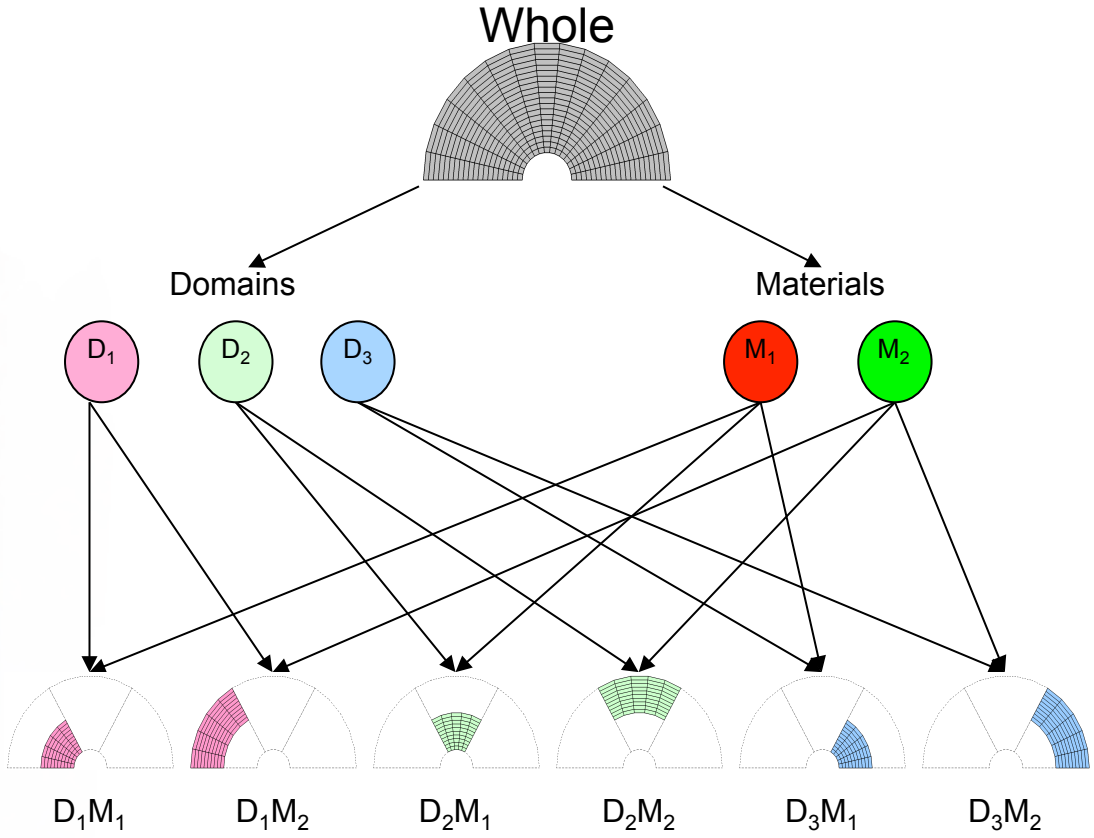
All domains are on



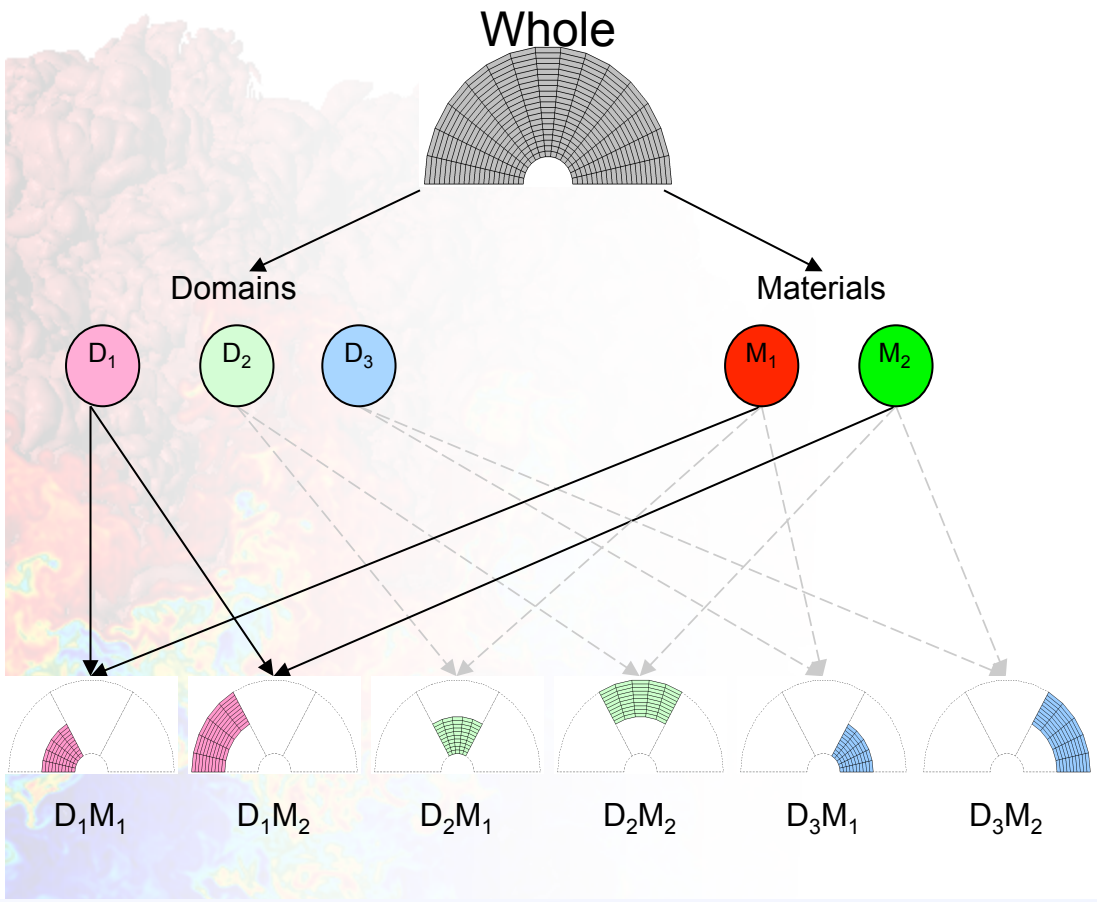
Domains 2,3 are off

# Example Setup

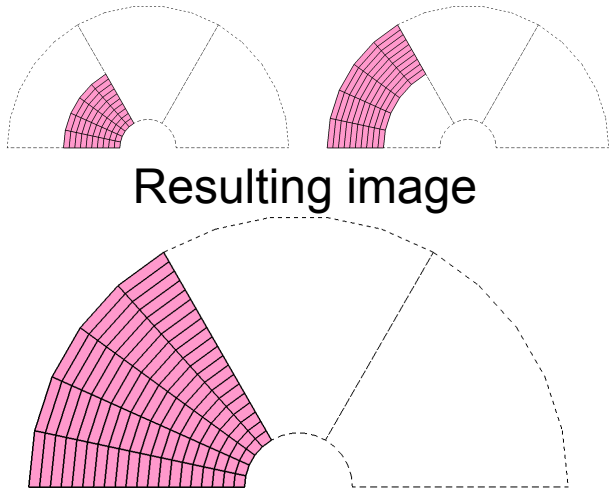


# Turning Off Domains 2,3



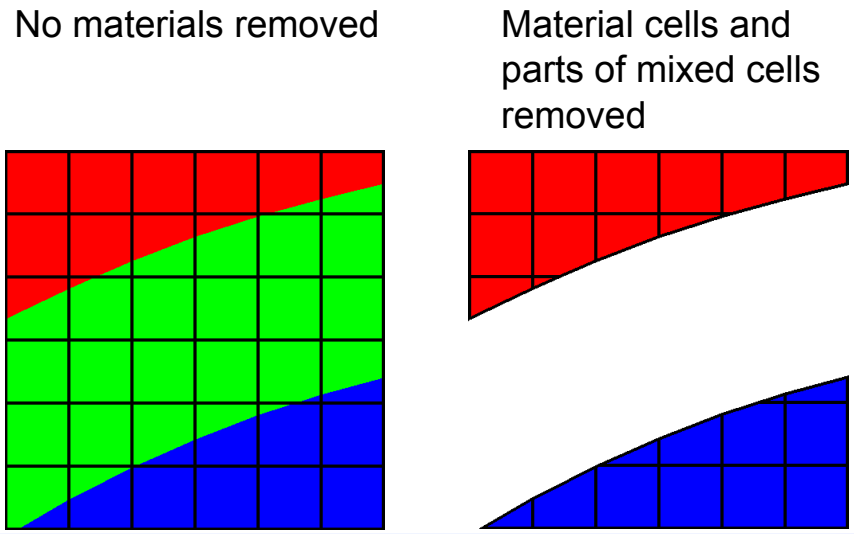

- After turning off domains 2 and 3, only subsets $D_1M_1$, $D_1M_2$ are left



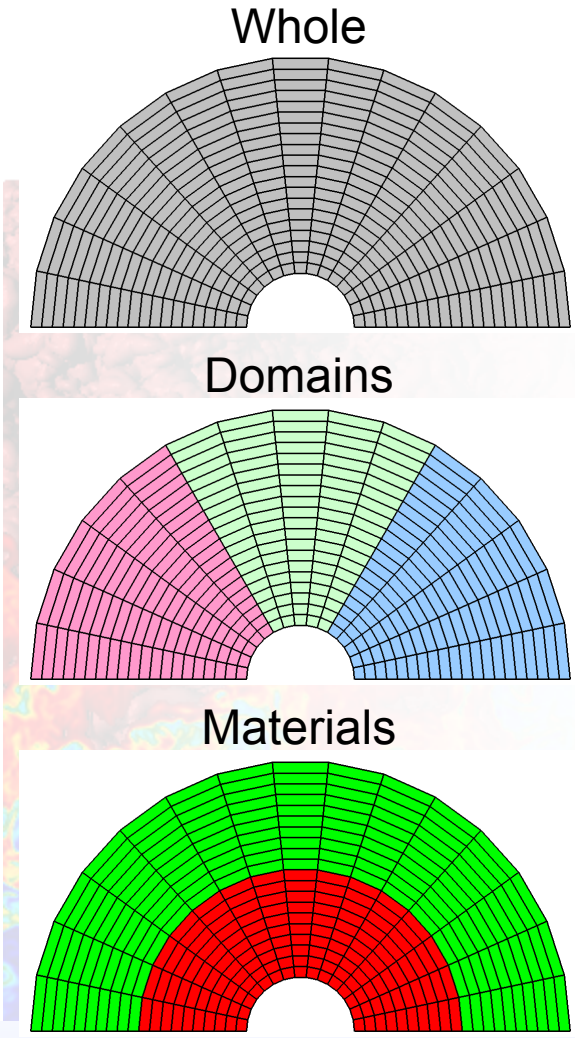
# Material Selection

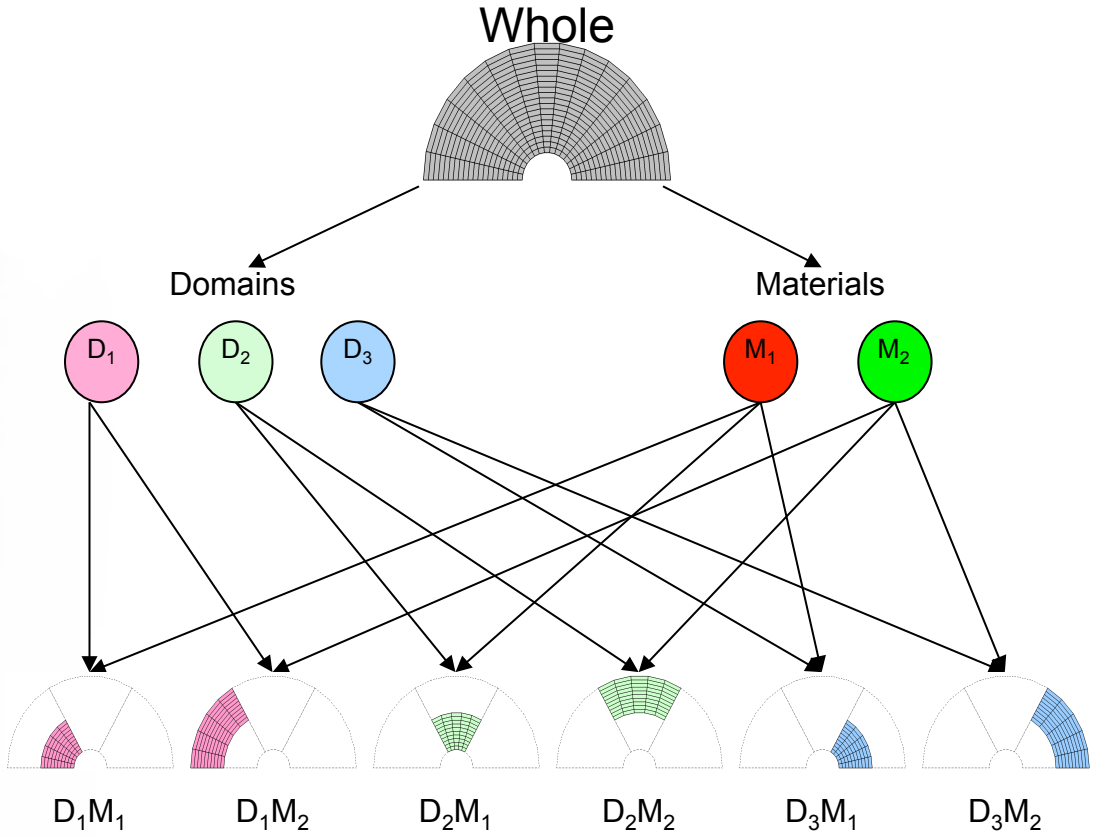
- Material selection is when you turn off subsets that are members of the Material collection
- Material selection removes cells or parts of mixed material cells that have the material being removed

- Why remove materials?
  - You might want to strip away outer materials (e.g. Air) so you can see into the interior of a 3D plot

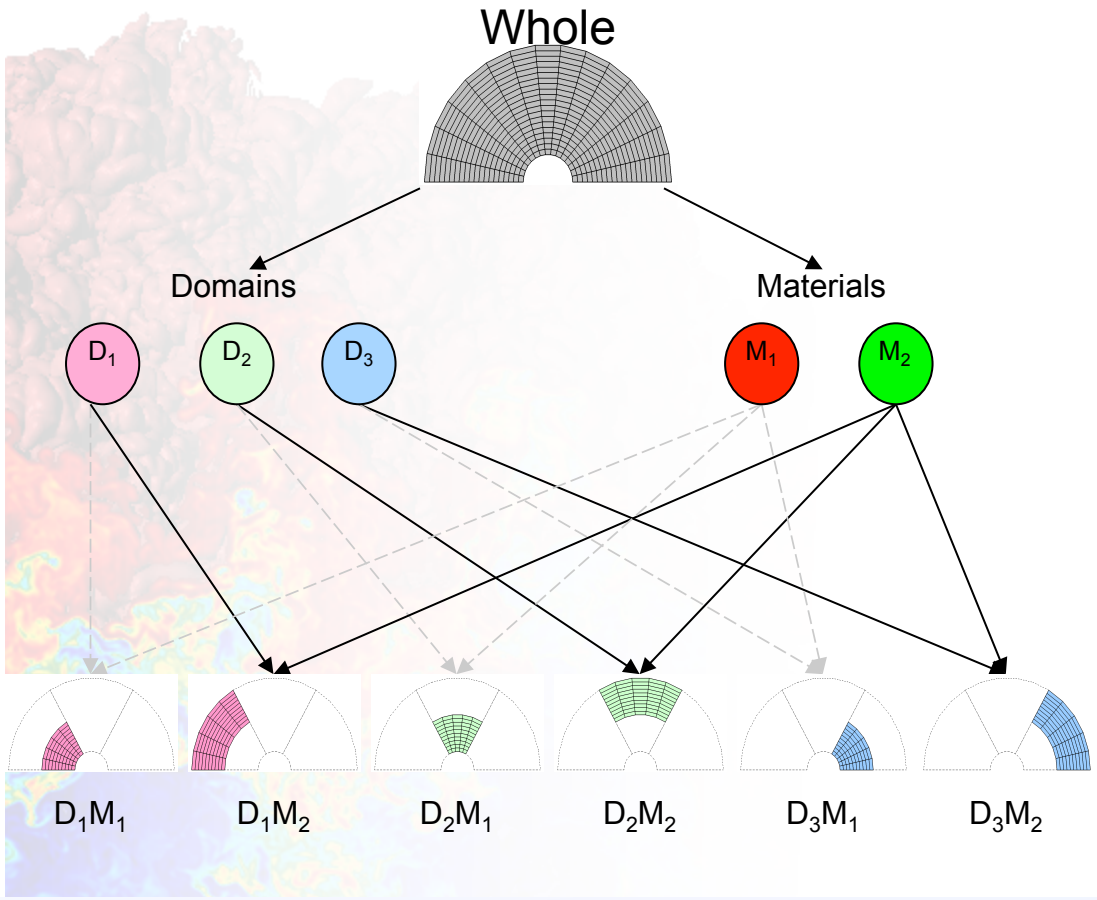


# Example Setup

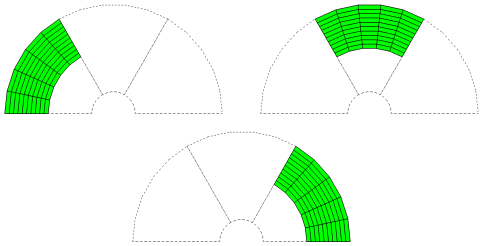


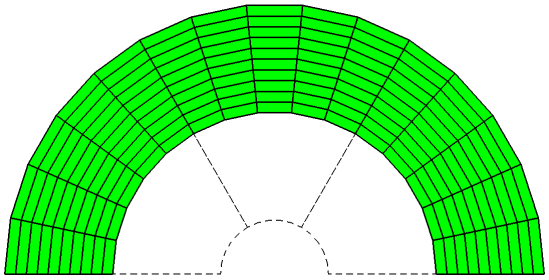
# Turning Off Material 1




- After turning off material 1, only subsets $D_1M_2$, $D_2M_2$, $D_3M_2$ are left



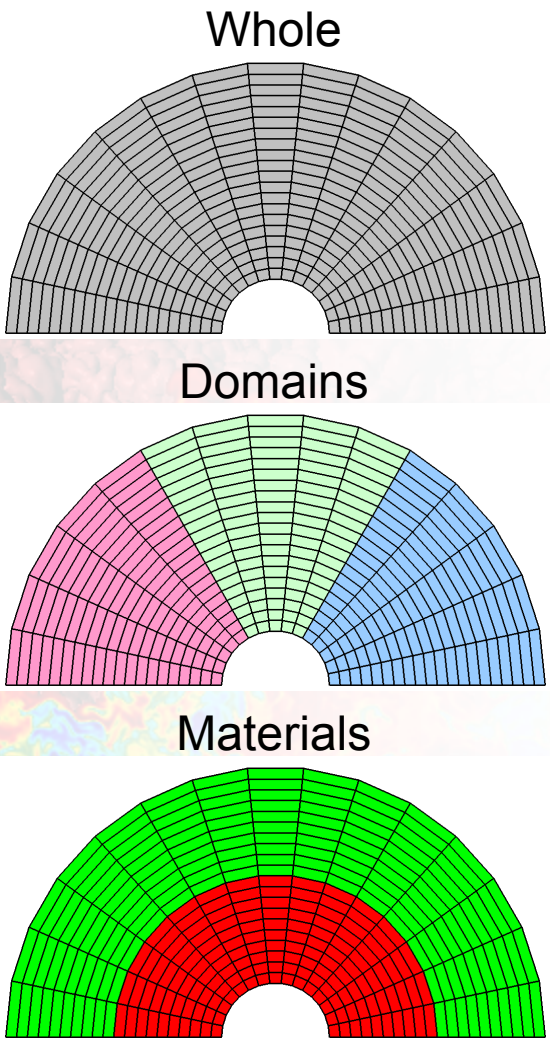
Resulting image

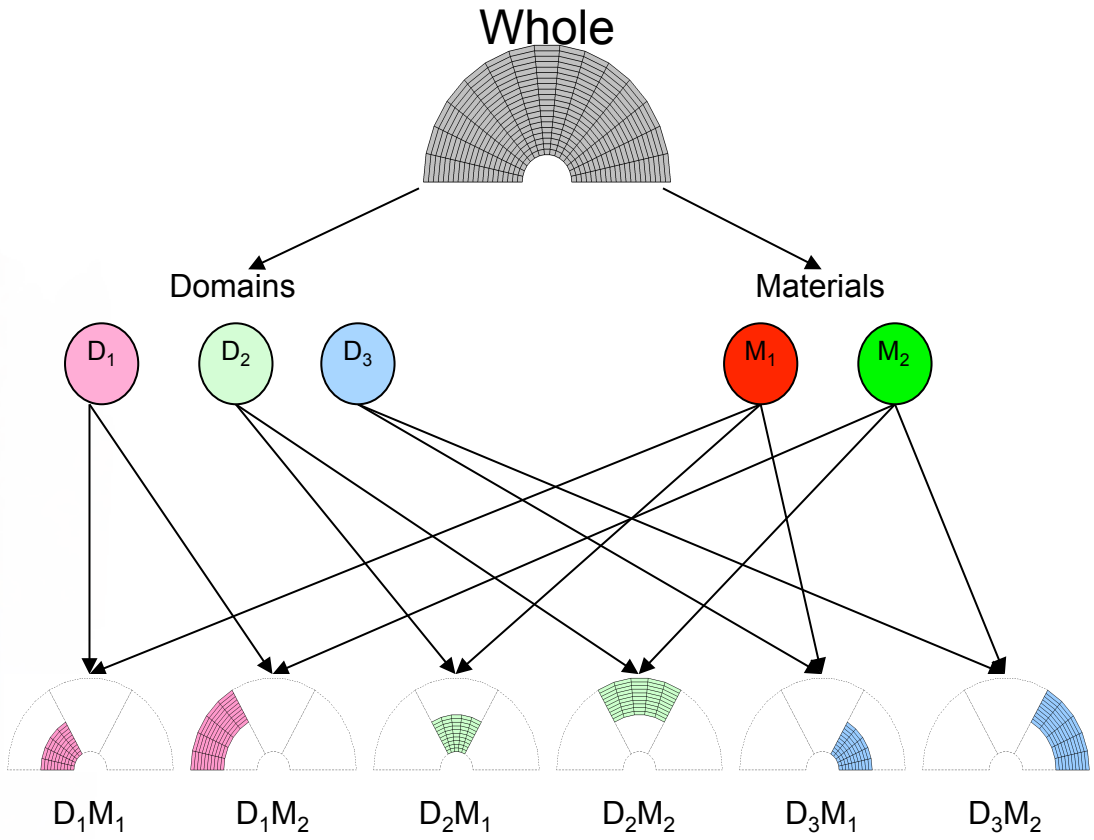


# Removal of subsets using multiple categories

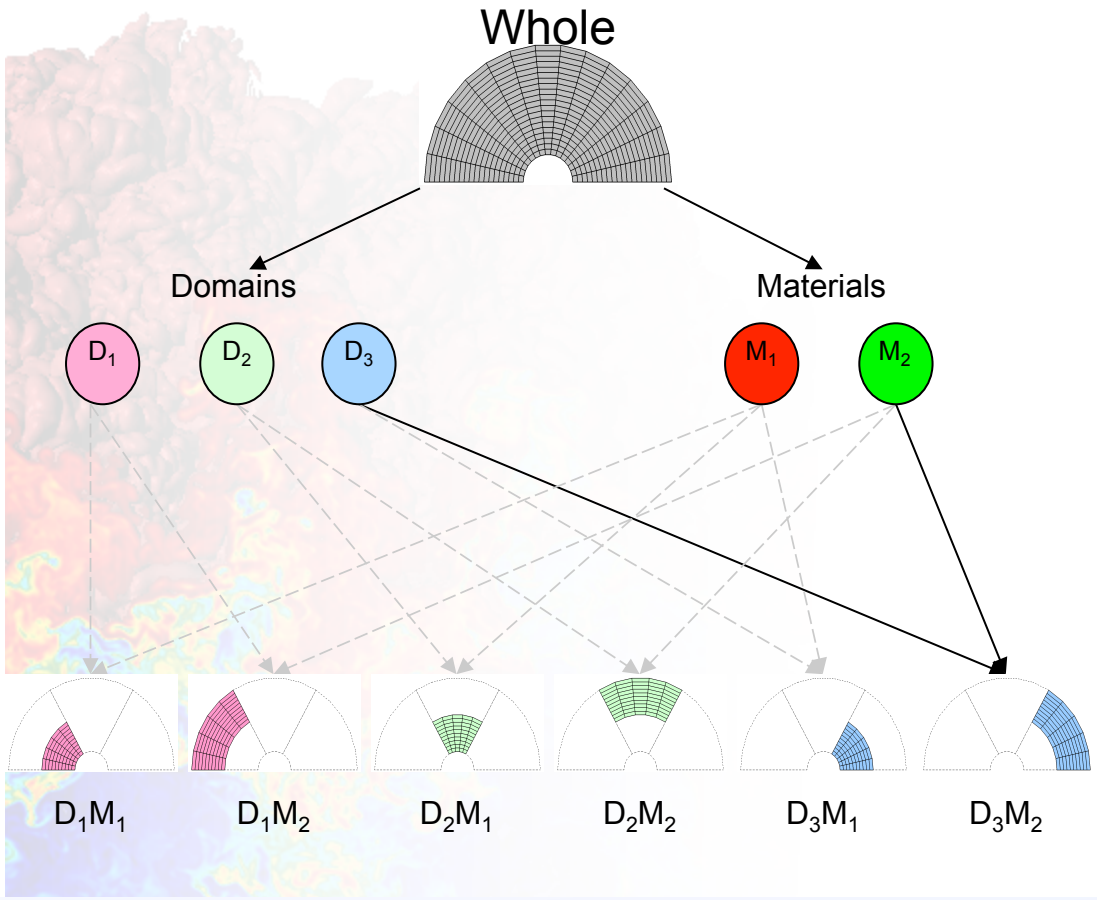
- VisIt allows each set in the SIL to be independently selected. This lets you remove sets using different subset categories
- Why is this useful?
  - It allows you to refine your search for cells that match certain criteria (e.g. Show me only cells from domain 1 that contain aluminum)

# Example setup



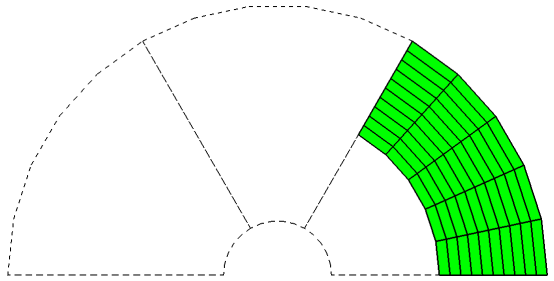



# Only Show Subsets That Have Material 2 in Domain 3



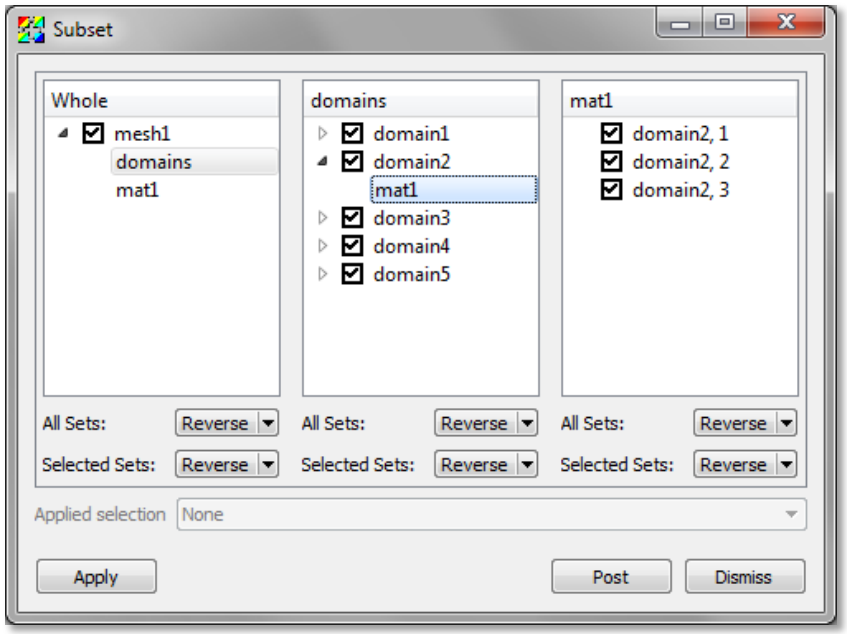

- When asking for only cells that contain material 2, we eliminate all subsets that only contain material 1. Similarly, asking for domain 3 removes all other domains

Resulting image



# Subset Window

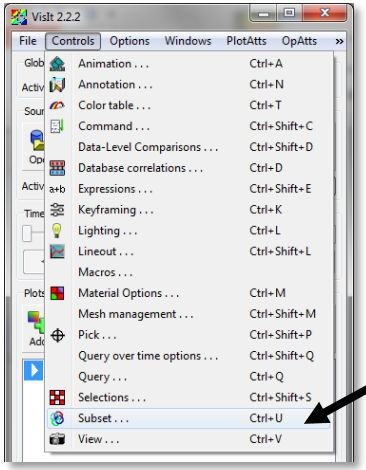
- VisIt provides a Subset window that allows you to turn a plot's subsets on and off to restrict the SIL
- Uncheck checkboxes to turn off subsets
- Make complex subsets

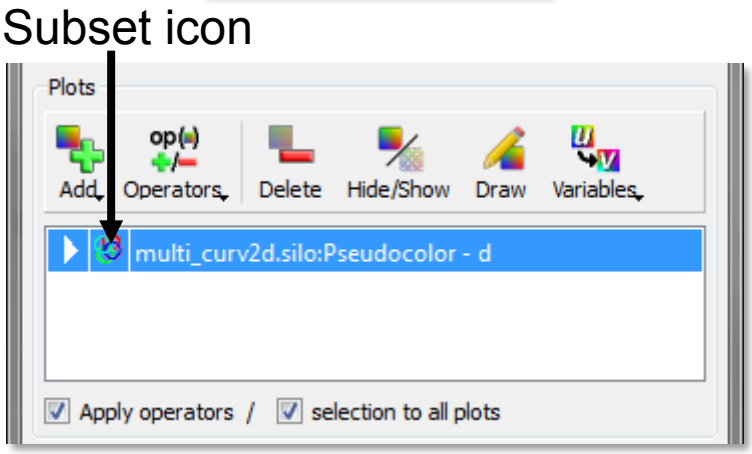


# Activating the Subset Window

- There are two ways to activate the Subset window

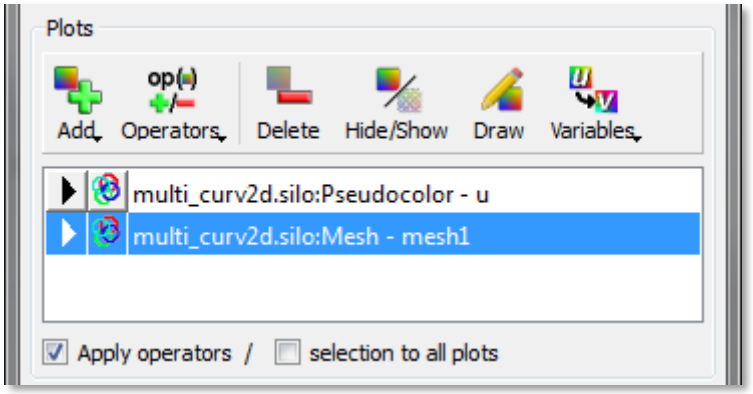
1. Select ***Subset…*** from the Main window's Controls menu
2. Click on a plot entry's ***Subset icon*** in the plot list



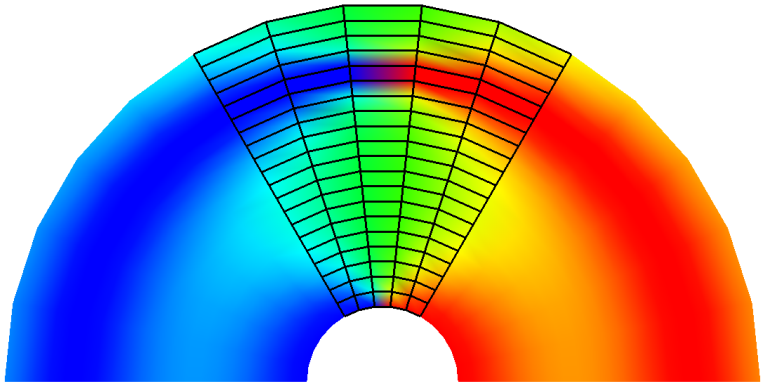



# Subsetting in VisIt

- Each plot has its own SIL restriction that corresponds to its database
- The SIL can be modified for all plots or for individual plots
- Changing the SIL for a plot from database **A** causes new plots from database **A** to get the last SIL for database **A** if the new plot's variable is compatible with the plot that set the SIL restriction

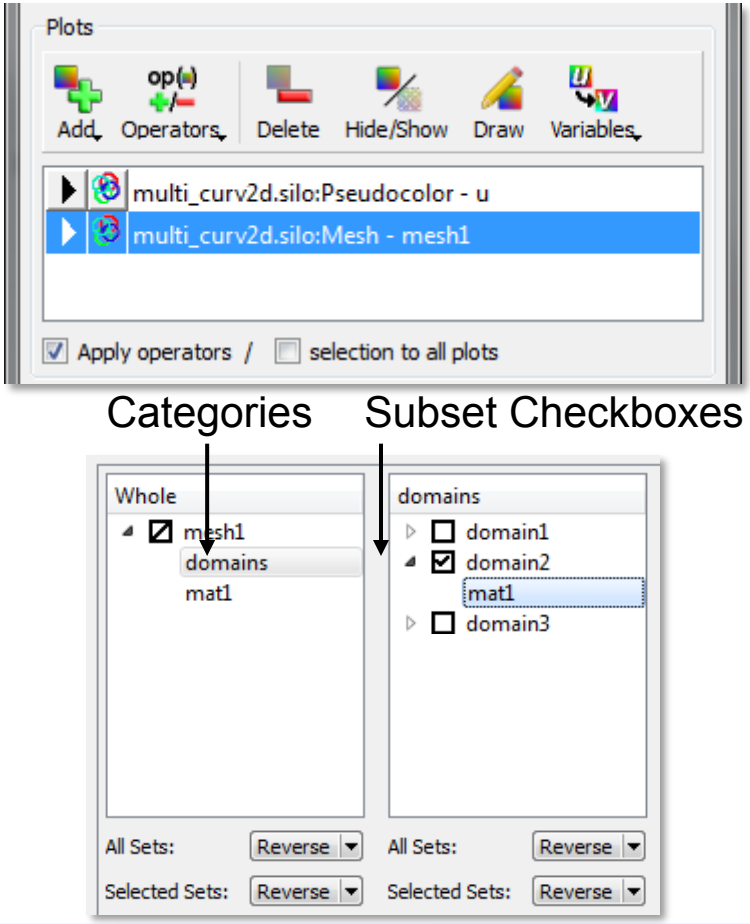



Note that the mesh plot has a different SIL restriction than the Pseudocolor plot



# Example: Turning Off Domains

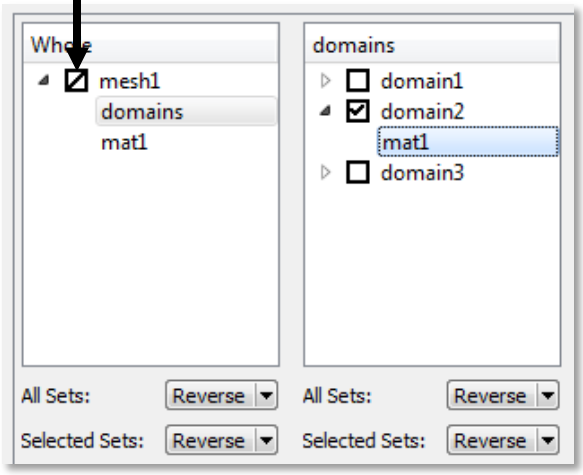
- Select the plot whose SIL restriction you want to change
- The Subset window shows the SIL restriction for the selected plot(s)
- Select the category for the subsets that you want to remove. This will cause VisIt to display relevant subsets in the next pane to the right
- Turn off domain subsets by clicking on their checkboxes
- Turning off a category or set turns off all of its subsets



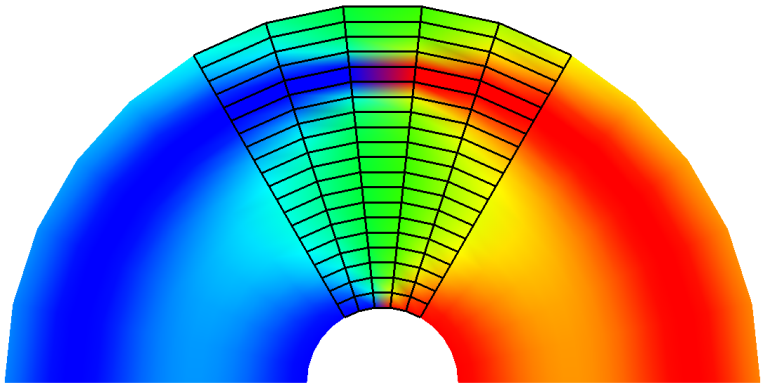
# Example: Turning Off Domains

- When a subset or subset category has subsets that are turned off, the subset checkbox has a slash through it to indicate that some subsets are on and some are off
- Each pane in the Subset window provides All, None, Reverse buttons to set the turn subsets in that pane on or off en masse

Subset checkbox with slash

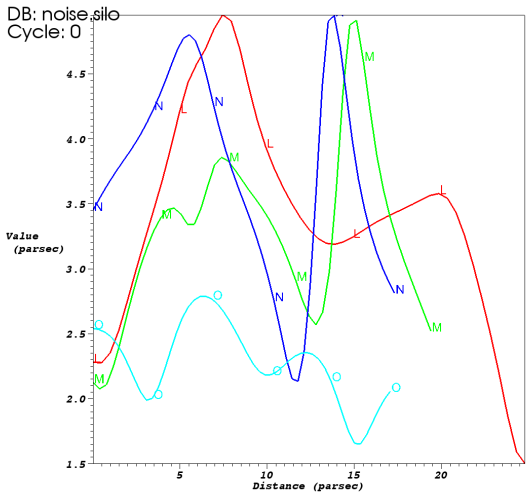



The Mesh plot has domains 1,3 turned off



# Exercise Group 7

# Quantitative Analysis



# Lesson Goals

- In this lesson, you will learn about extracting data values from plots using
  - Expressions
  - Pick
  - Lineout
  - Queries
- *These are all capabilities that can be combined using scripting to produce more powerful tools*

# Expressions

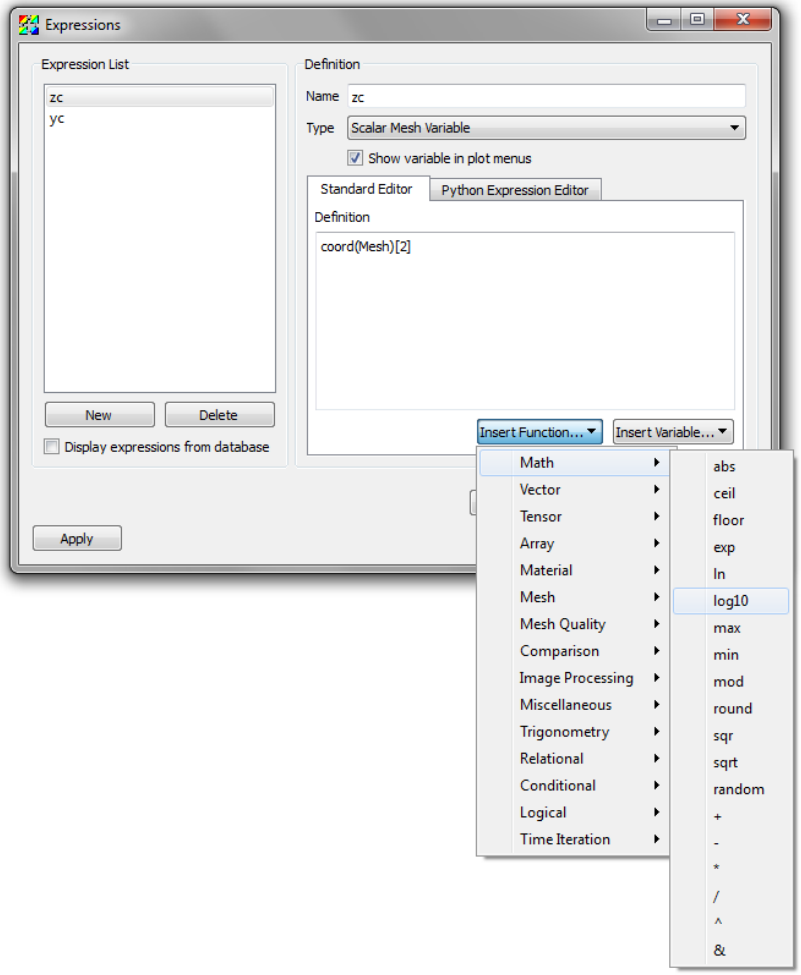
- VisIt allows you to create new derived variables from values in your database using VisIt's expression language
  - Use expressions to derive quantities that were not stored in your database
  - Expressions can operate on scalars, vectors, tensors
  - VisIt provides many types of functions
  - Write new custom expressions using Python scripting

# What is a Valid Expression?

| Type | Description | Example |
|---|---|---|
| Infix operators | + - * / ^ | A+b^c (a+b)*c |
| Constants | Scalar constants and strings | 3e4 10 true false |
| Vector compose | {} | {a, b} |
| Lists | [value, …] [n:m] | [1,2,3] [1:5, 6, 10:12] |
| Identifiers | Name of variable | Density tmat |
| Database variables | <> Indicates name of actual database variable | <pressure> <domain0/ pressure> |
| Functions | | if(lt(pressure, 5.), 1., 0.) |

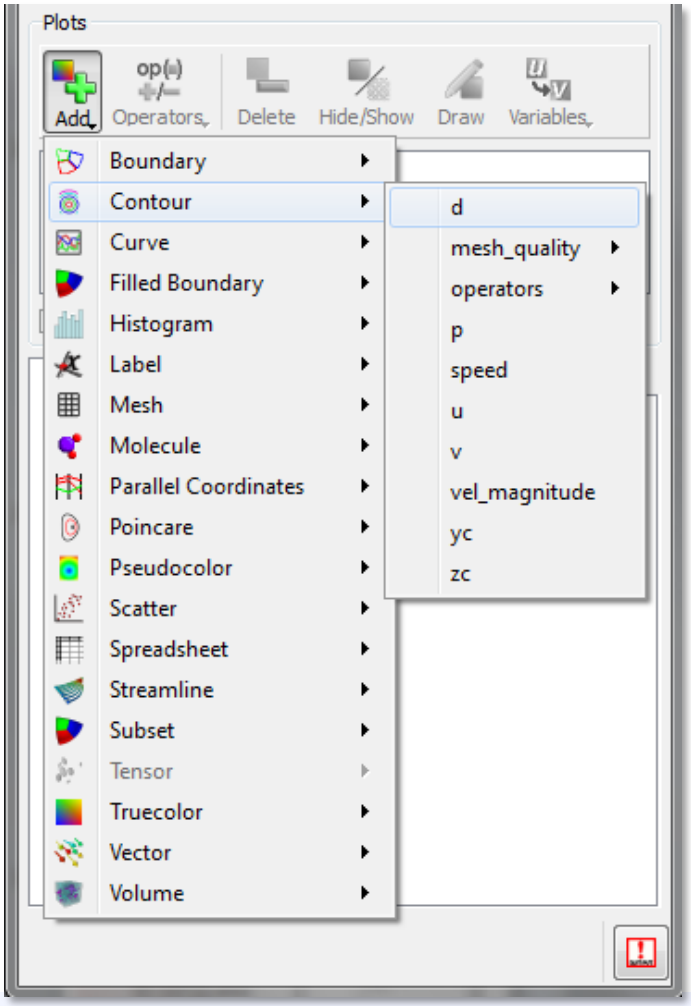
# Creating Expressions

- You can create expressions using the Expression window
  - Click New button to create new blank expression
  - Fill in name, type, definition
  - Click Apply button
  - You can use the Insert Function menu to add a new function to your expression
  - You can use the Insert Variable menu to add a new variable from the active database to your expression
- Databases can define expressions



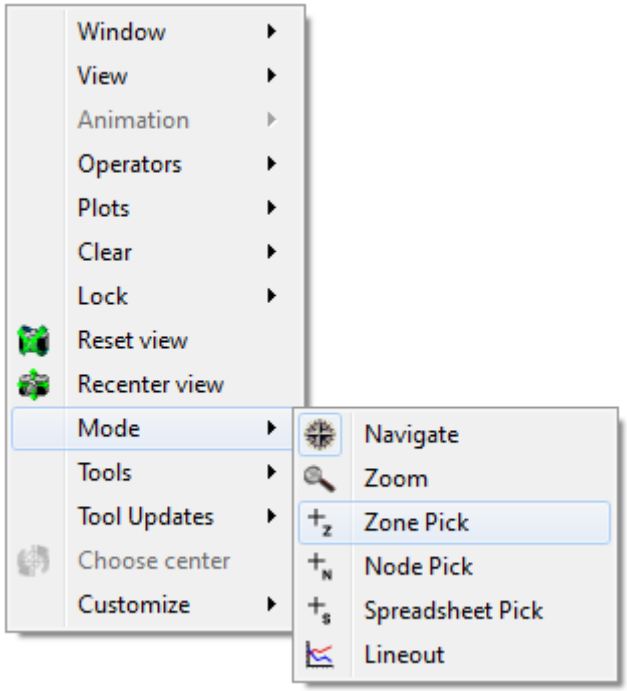
# Using Expressions

- Once an expression variable is defined, it appears in the variable lists for the plots
- Select the expression variable as you would any other variable to use it in a plot



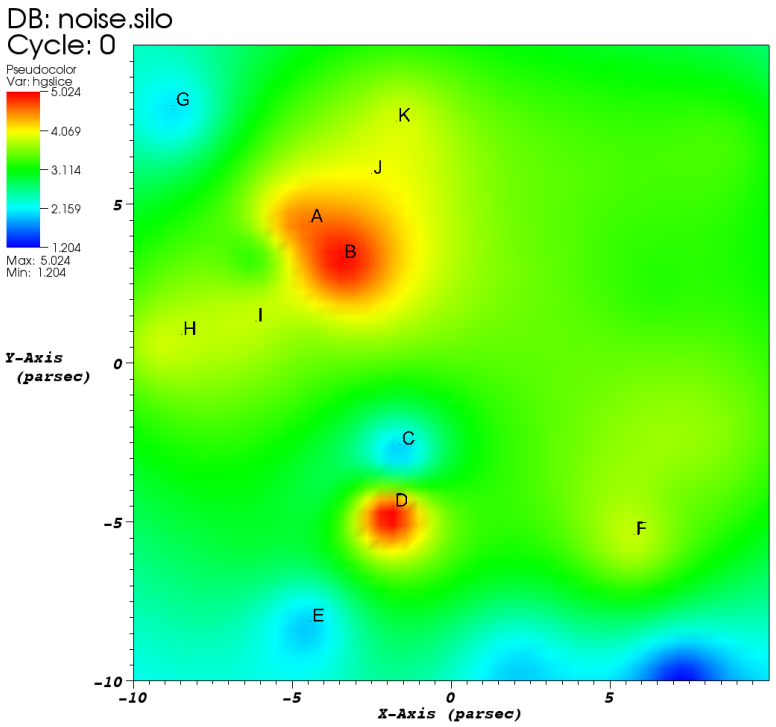
# Pick

- Interactively pick values from visualized data using vis window's Pick mode
- Each click causes VisIt to determine variable values for selected plot at pick point
- Essential tool for performing data analysis
- 3 pick modes
  - Zone pick
  - Node pick
  - Spreadsheet pick
- Enter a pick mode using vis window's mode menu



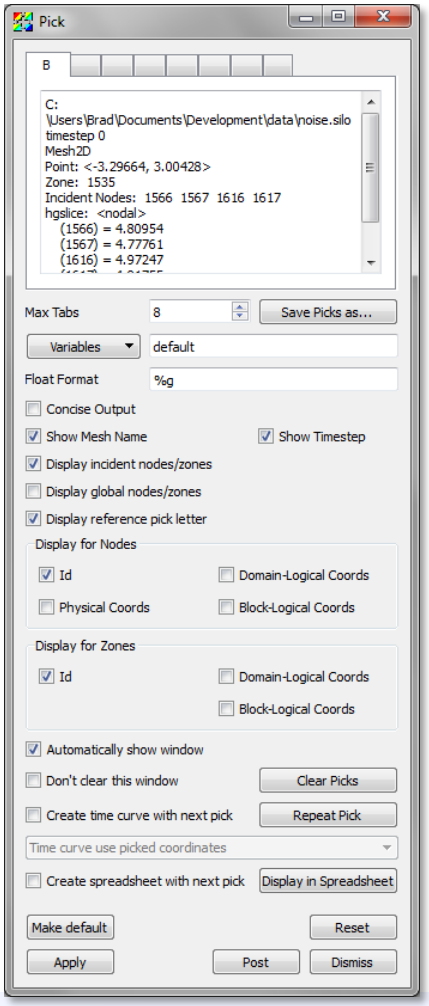
# Pick

- Each pick point leaves a marker that you can use to match with the pick information displayed in the Pick window



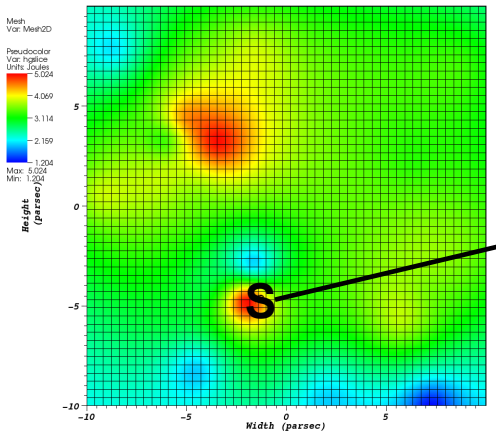
# Pick Window

- Displays pick information in tabs
- All pick information visible in Output window too
- Automatically appears when user picks
- Set the pick variable(s) or use *default* to get pick information for the plotted variable
- Display logical zone or node indices



# Spreadsheet Pick

- Spreadsheet pick creates a Spreadsheet plot of the dataset used by the picked plot and the Spreadsheet plot highlights the pick cell




Spreadsheet - hgslice: domain0

File Edit Operations

3D

k=0 [0,0]

Normal X Y Z

Display

Format %1.6f

Color Default

Show in visualization window

Tracer plane Patch outline Current cell outline

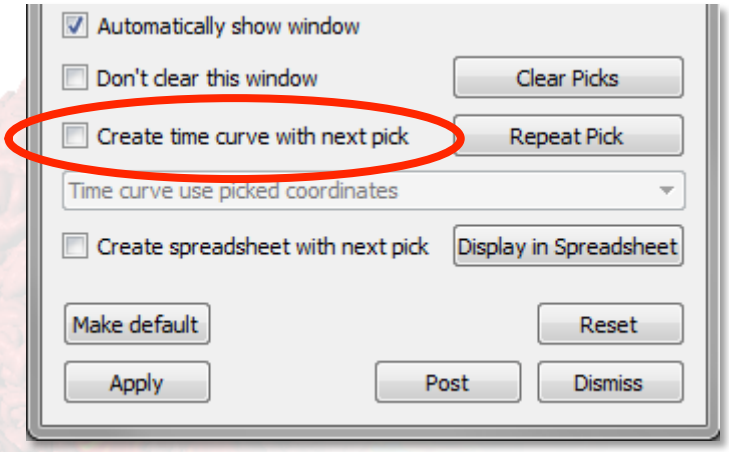
k=0

| | i=19 | i=20 | i=21 |
|---|---|---|---|
| j=17 | 2.267188 | 2.064635 | 2.070979 |
| j=16 | 2.731630 | 2.589565 | 2.545625 |
| j=15 | 3.516766 | 3.486990 | 3.340762 |
| j=14 | 4.373306 | 4.448427 | 4.160281 |
| j=13 | 4.891465 | 5.024092 | 4.658534 |
| j=12 | 4.823903 | S=4.953312 | 4.664707 |
| j=11 | 4.418107 | 4.521074 | 4.361797 |
| j=10 | 3.982911 | 4.065762 | 3.997550 |
| j=9 | 3.623230 | 3.696264 | 3.678582 |
| j=8 | 3.341988 | 3.412445 | 3.421595 |
| j=7 | 3.122817 | 3.194256 | 3.217337 |

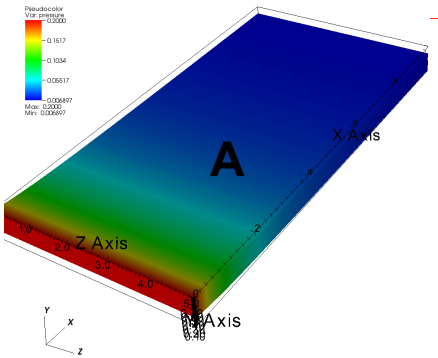
Variable hgslice

Min = 1.204454 Max = 5.024092

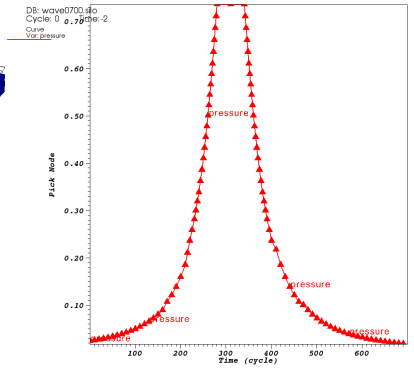
# Creating Time Curves With Pick




Time-varying data



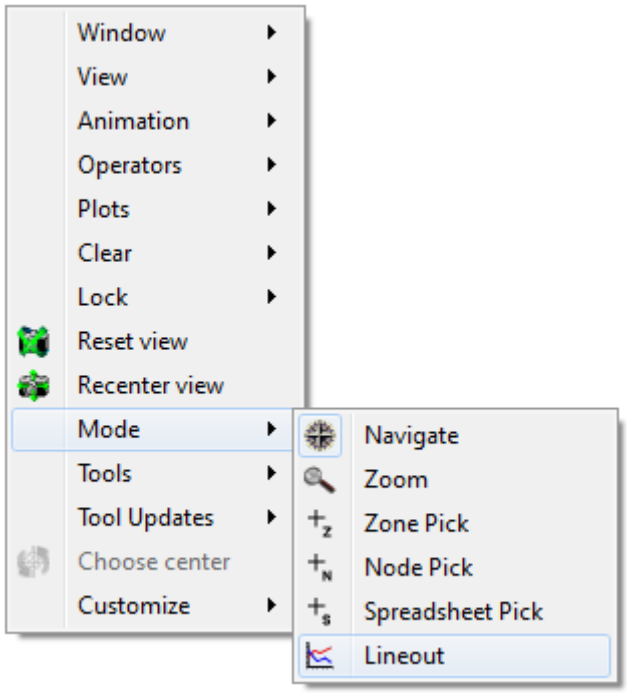

Time curve of picked node




- Pick can be used to generate a time-history plot of the zone/node that was selected by pick
- Turn on “Create time curve with next pick” in the Pick Window
- Use Zone pick if variable centering is zonal, else use Node pick

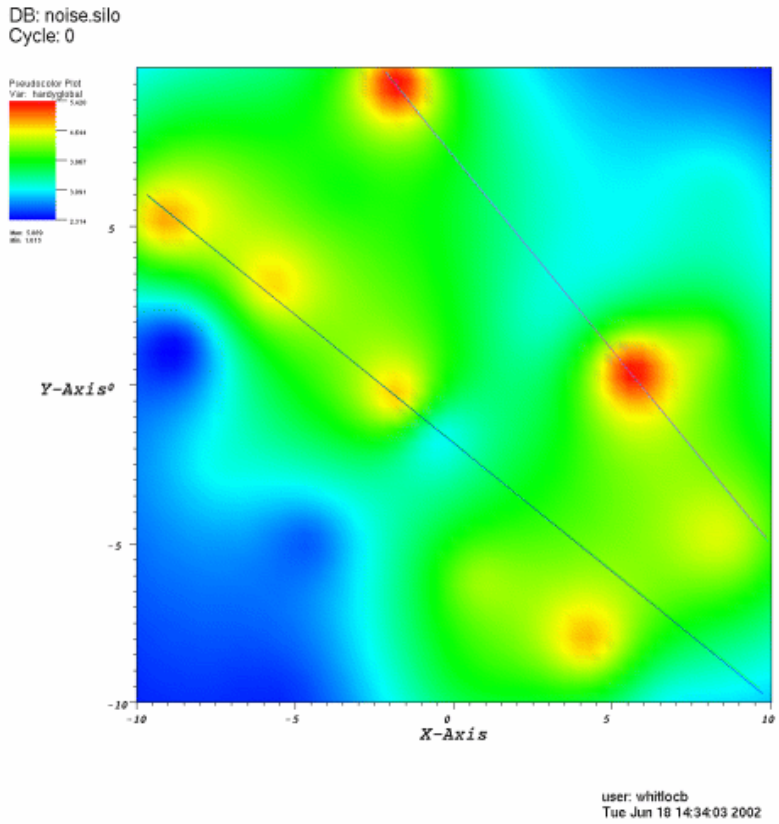
# Lineout

- Extracts 1D curves from higher dimensional data
- Curves are easy to compare
- Curves can be exported as XY text files for use in other analysis packages such as LLNL's *ULTRA*
- Vis window has Lineout mode
  - Draw a line to extract curve data along that line from 2D plots
  - Curve plotted in new vis window
  - Use popup menu's Mode menu to enter Lineout mode

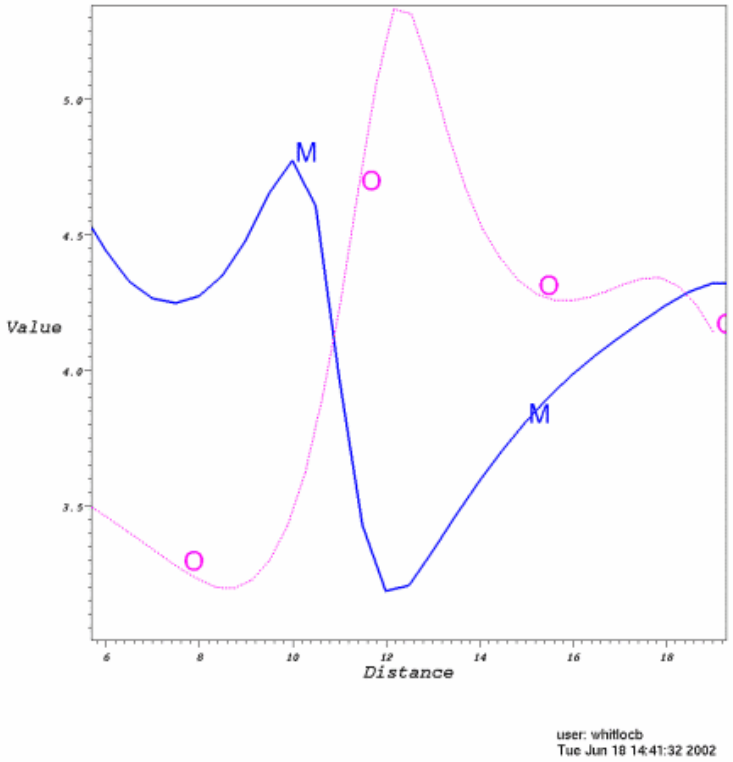


# Lineout

Original 2D plot




Curve plots derived from extracted data



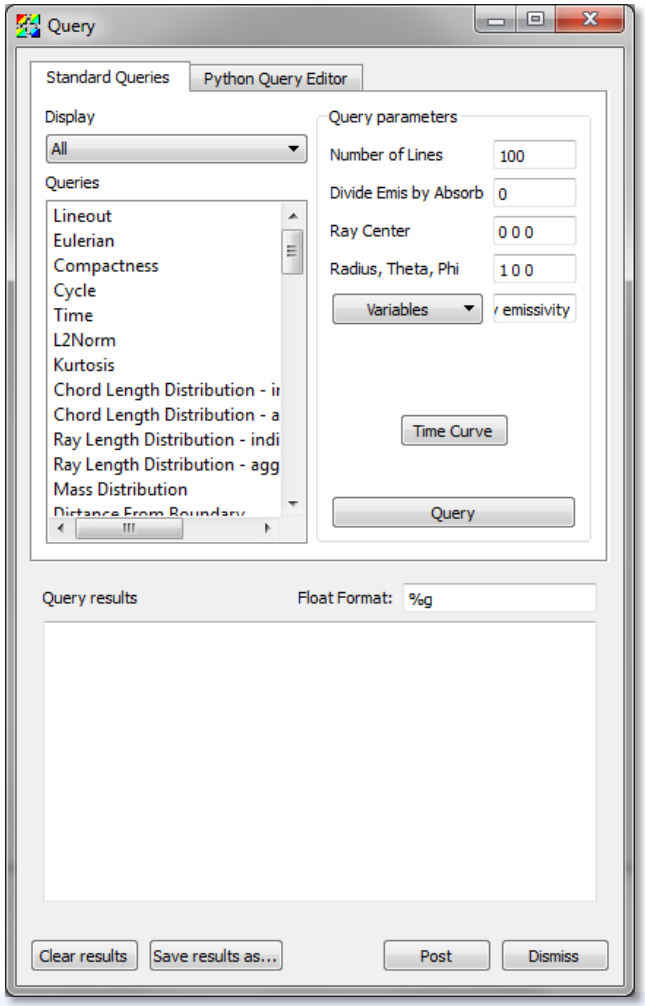
# Queries

- VisIt provides queries so you can compute values about
  - An entire database
  - A plot
  - A point in a database
  - A linear path through a database
- Pick and Lineout are queries
  - Use Query window to precisely specify pick point or lineout endpoints
  - Lineout query can create curves for 3D data

| Selected Queries *(there are many more)* | |
|---|---|
| ZonePick | Best fit line |
| NodePick | Population Statistics |
| PickByNode | Sample Statistics |
| PickByZone | Volume |
| Lineout | 2D area |
| Cycle | 3D Surface area |
| Time | VariableSum |
| L2Norm | MinMax |
| Integrate | Spatial extents |
| L2Norm between curves | Chord Length Distribution |
| Area between curves | Shapelet Decomposition |

# Query Window

- Lists all available queries
- Lets you enter query parameters
- Displays query output
- Certain queries provide a Time Curve button that calculates the query on each time step and creates a curve from the results
- Custom queries can be written in Python



# Exercise Group 8

# Making it Pretty

# Lesson Goals

- In this lesson, you will learn how to add some polish to your visualizations
- Attributes that make all the difference
  - Annotations
  - Colors
  - Lighting
  - View

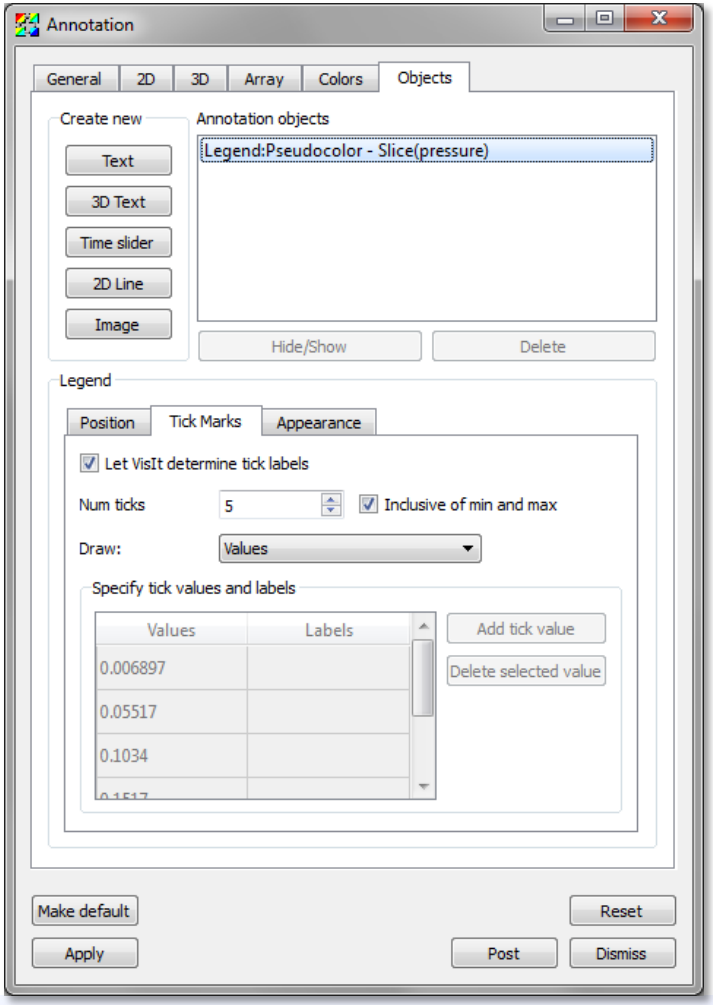
# Annotations

- Annotations are objects in the vis window that convey information about the plots
- Annotations make clear what is being visualized and make the visualization appear more polished

- Types of annotations
  - Database name
  - User name
  - Plot legends
  - Plot axes and labels for 2D and 3D
  - 3D Triad
  - 2D, 3D text
  - Time slider
  - Images
  - Lines and arrows

# Annotation Window

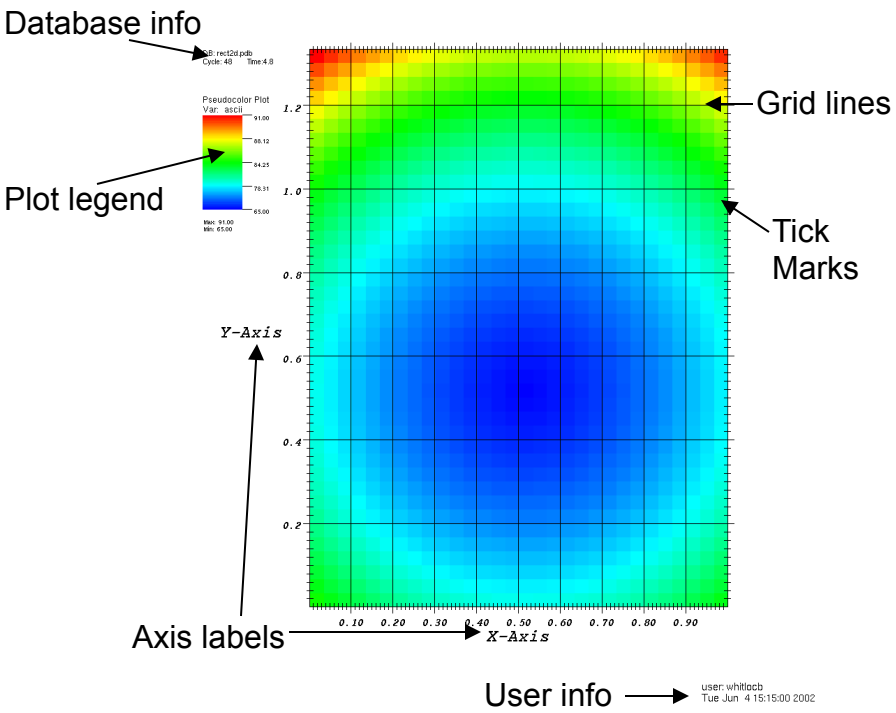
- Split into 6 tabs
  - General annotations
  - 2D axis settings
  - 3D axis settings
  - Array axis settings
  - Colors and Backgrounds
  - Annotation objects
    - Legend, Time slider, …
- Many of the tabs are themselved tabbed
- There are a lot of options in this window!



# 2D Annotations

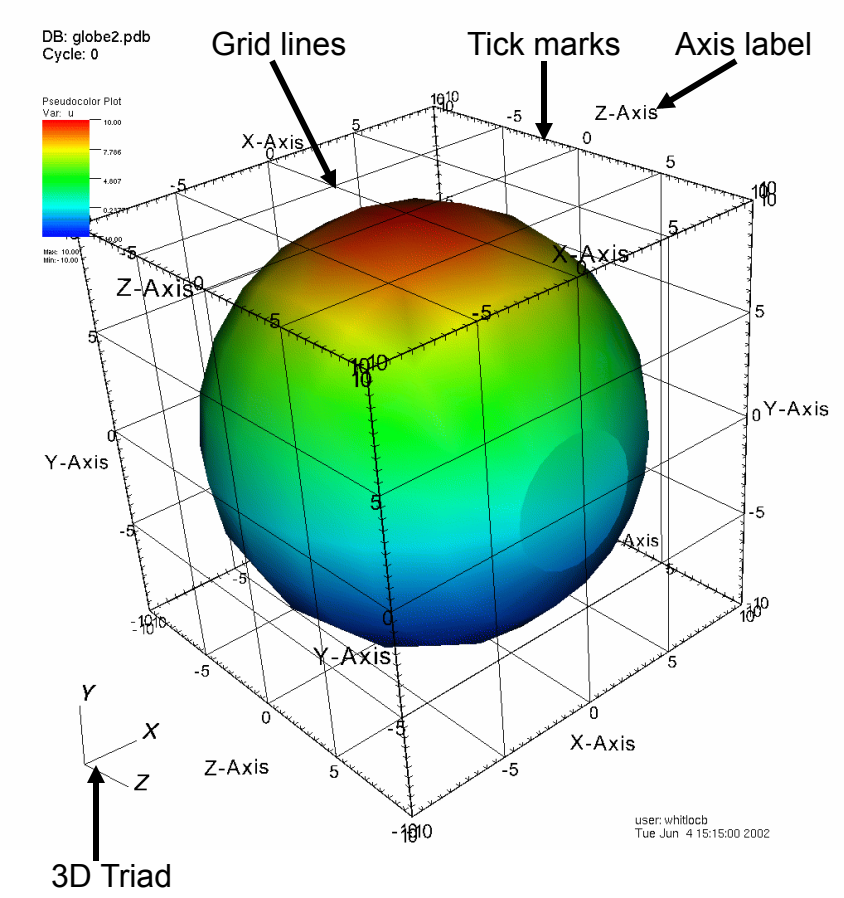
- VisIt has numerous controls in the Annotation Window to control 2D settings
- These settings are concerned with appearance of the axes that frame plots of 2D databases
- Each axis can be controlled using different tabs on the 2D tab

2D Plot with annotations

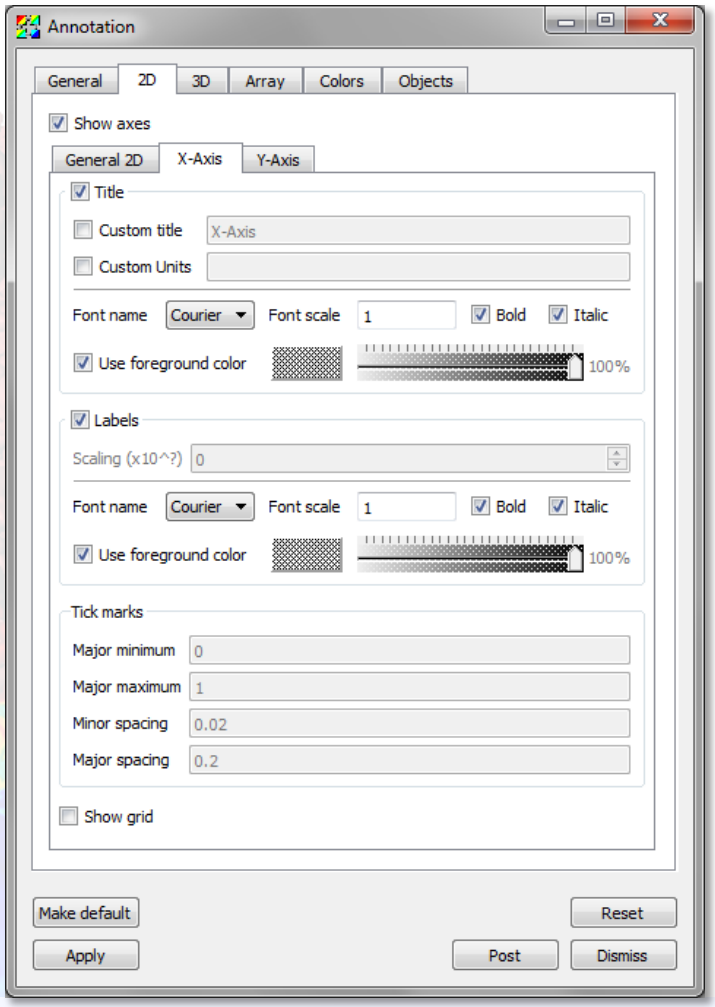


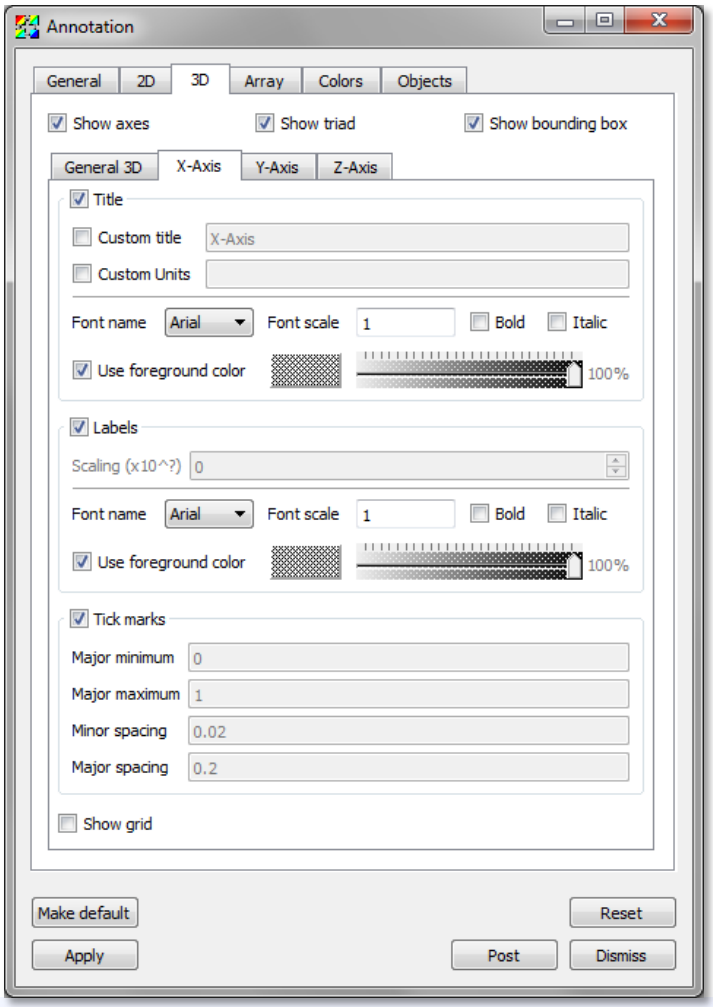
# 3D Annotations

- VisIt's Annotations Window (3D tab) provides a number of options for
  - Grid lines
  - Tick marks
  - Axis labels
  - Axis type
  - 3D Triad
- Each axis can be controlled using different tabs on the 3D tab



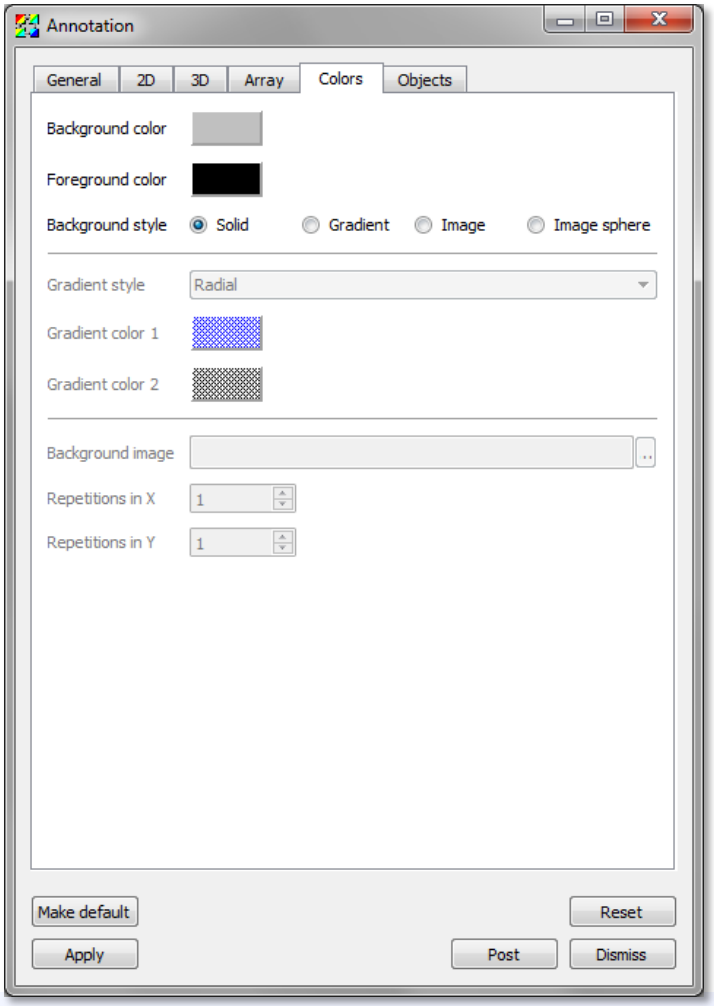
# 2D and 3D Annotation Window Tabs



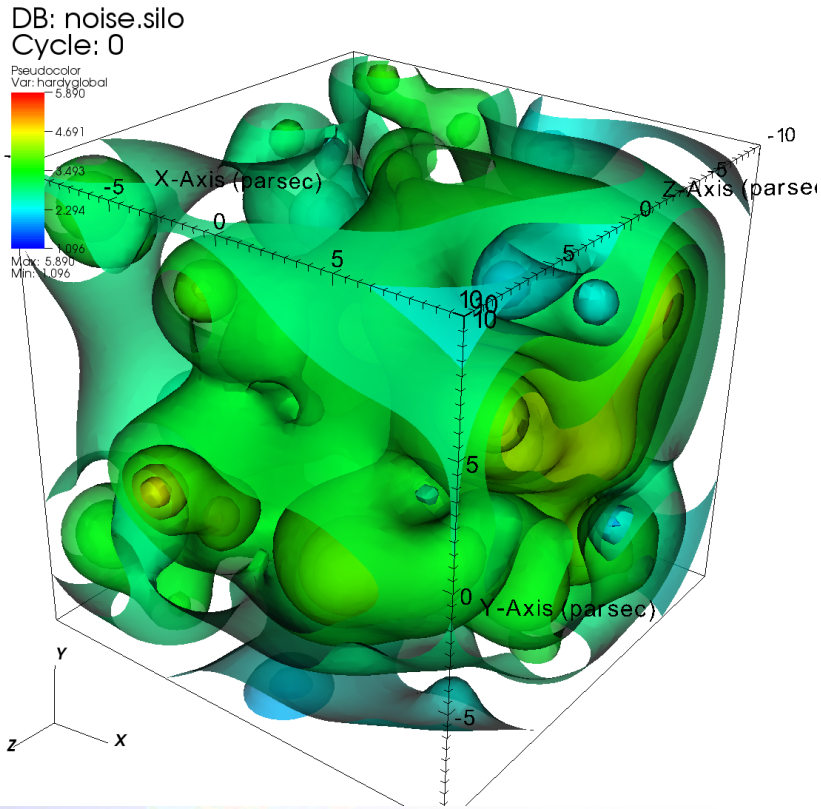



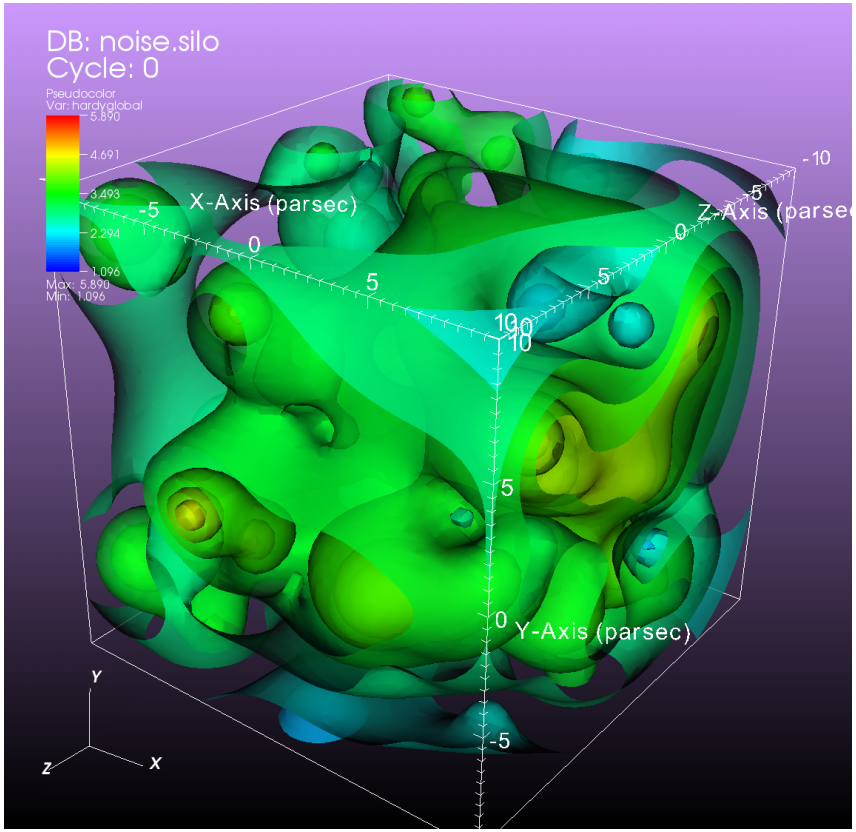
# Colors and Backgrounds

- Set the background and foreground for the visualization
- Background styles
  - Solid
  - Gradient
  - Image
  - Image sphere



# Gradient Background



# Image and Image Sphere Background

- Image backgrounds let you put a flat image behind your plots
- Image sphere backgrounds warp an image around a sphere that rotates with the view
- Set the number of repetitions of the image

Black background

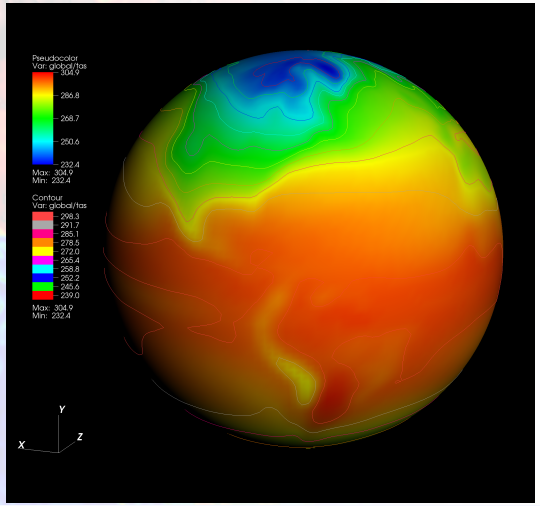
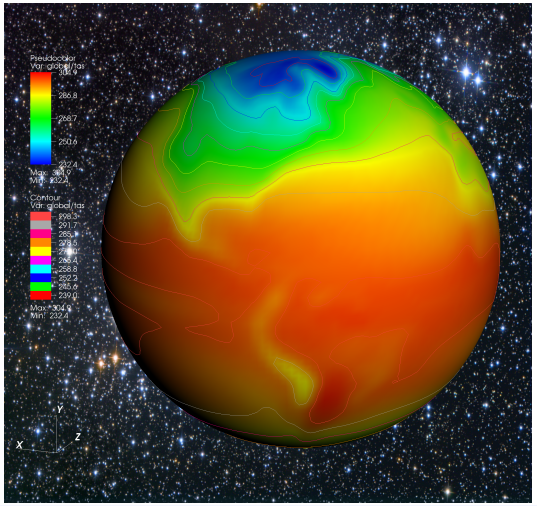
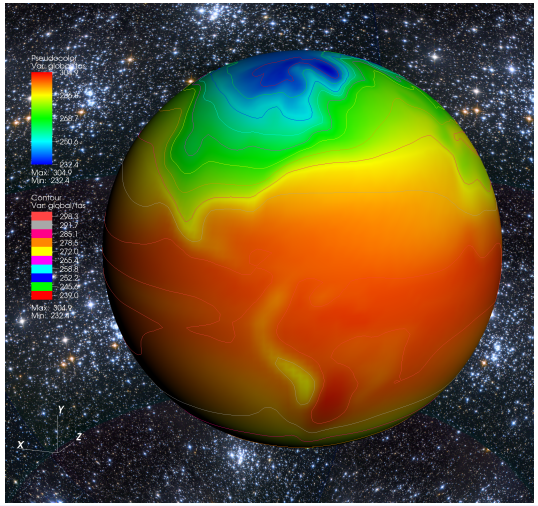


Image background

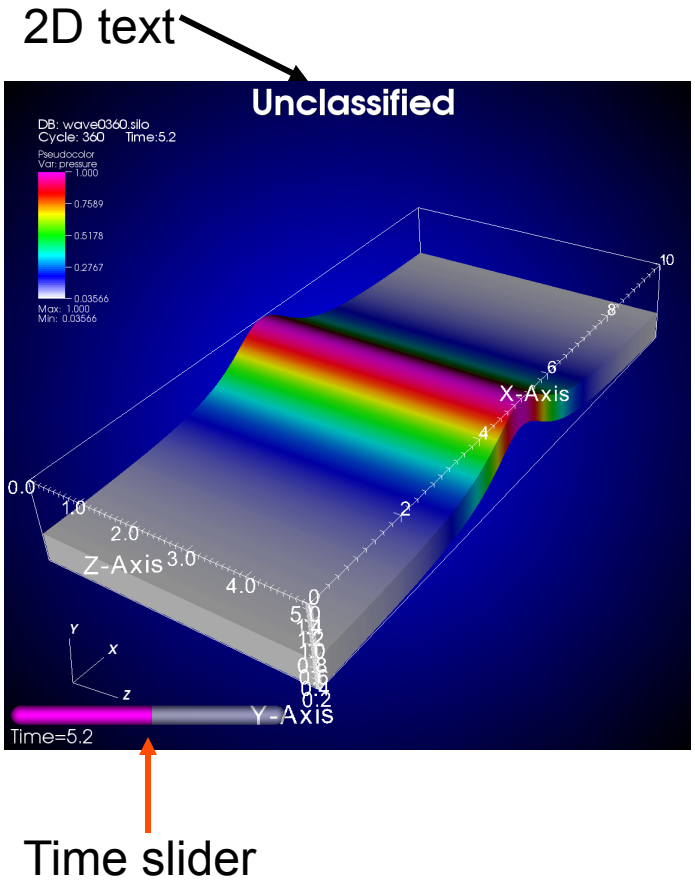


Sphere background

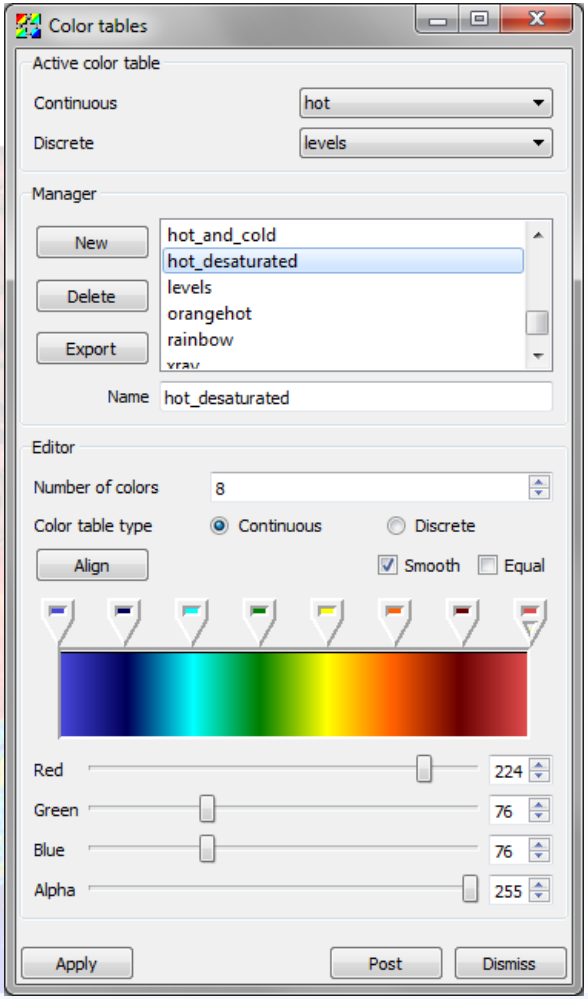


# Annotation Objects

- VisIt provides currently provides 6 types of annotation objects
  - Time slider
  - 2D text
  - 3D text
  - Image
  - Line/arrow
  - Legend
- Time slider shows progress through an animation
- 2D text shows any text string
- Image shows an image such as a logo
- Line/arrow allows you to point to specific visualization features
- Other objects are planned
  - Text Boxes
  - Lines
  - 3D Arrows
  - Background Images
  - 3D shapes
  - 3D text



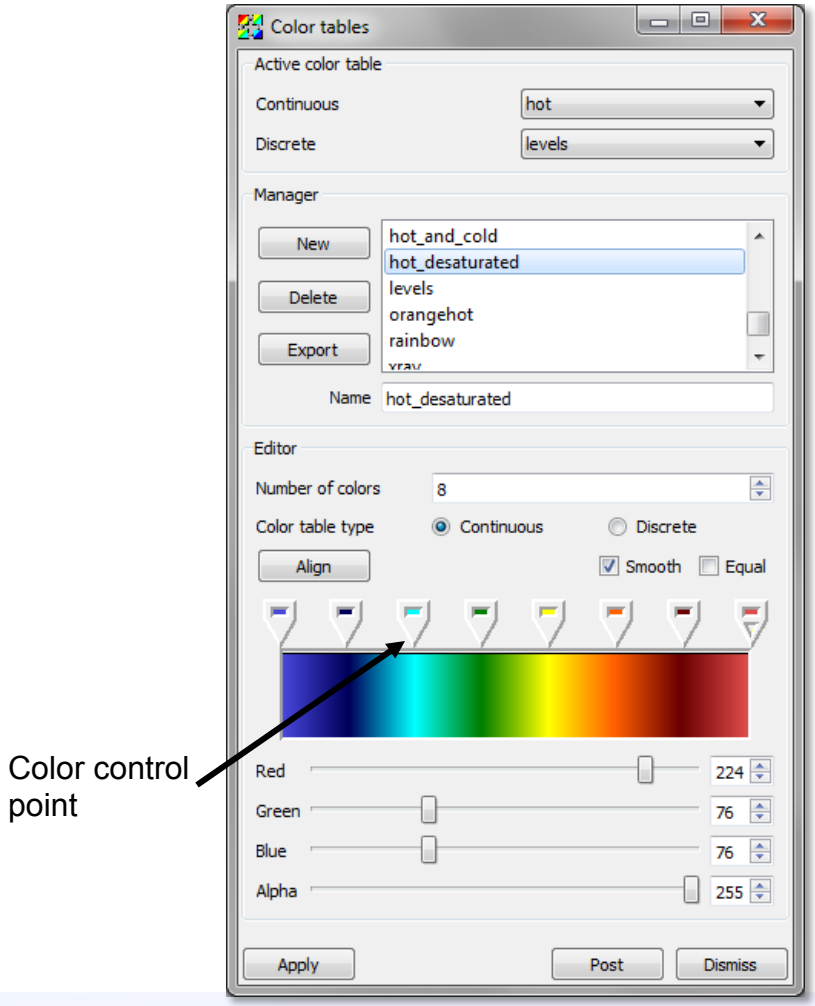
# Color Table Window




- A color table is a set of colors that VisIt uses to color plots
- Color tables come in two types
  - Continuous
  - Discrete
- Continuous tables are used by several plots including Pseudocolor, Streamline, and Vector plots
- Discrete tables are used by Contour or Subset plots
- There are several built-in color tables
- Edit existing color tables
- Design your own custom color table

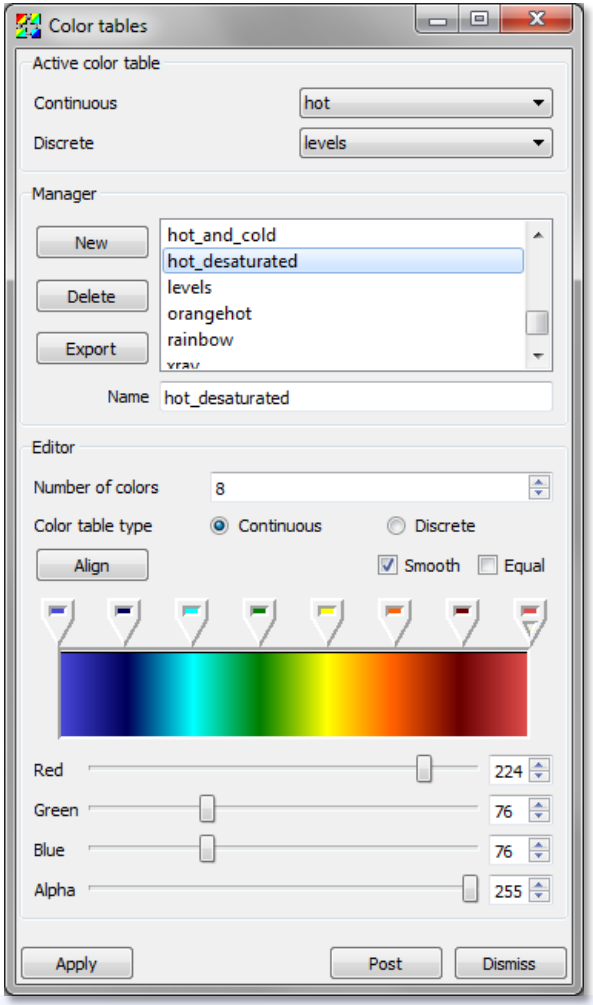
# Color Tables, Continued…

- The color table window lets you
  - Set the active color table
  - Create a new color table
  - Delete a color table
  - Edit a continuous color table
- You can modify a color table by adding, removing, moving or changing the color of its color control points

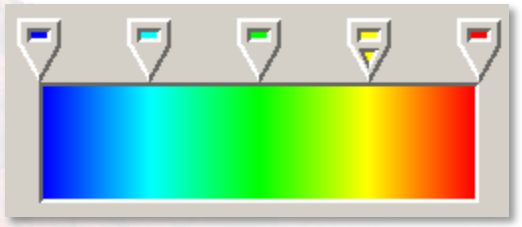


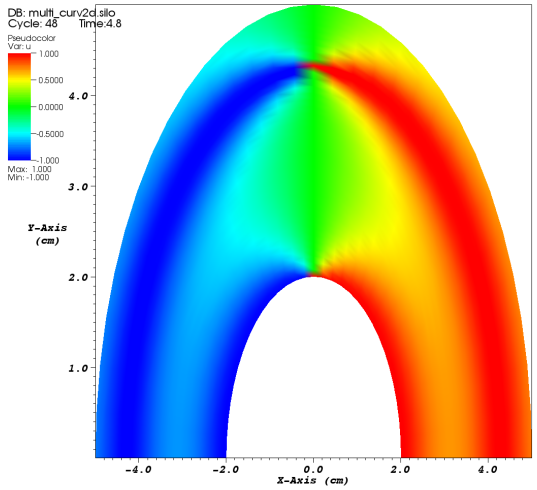
# Editing a Continuous Color Table

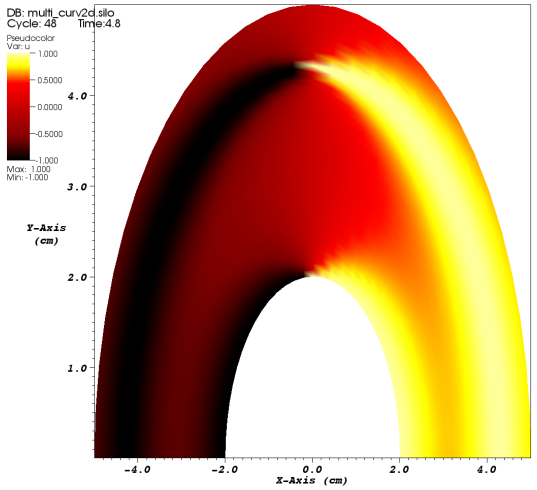
- To change a color table definition, you must alter its color control points, their colors and locations
- The color control points are represented by pointy boxes just above the color spectrum
- Clicking the Align button makes all color control points have equal spacing



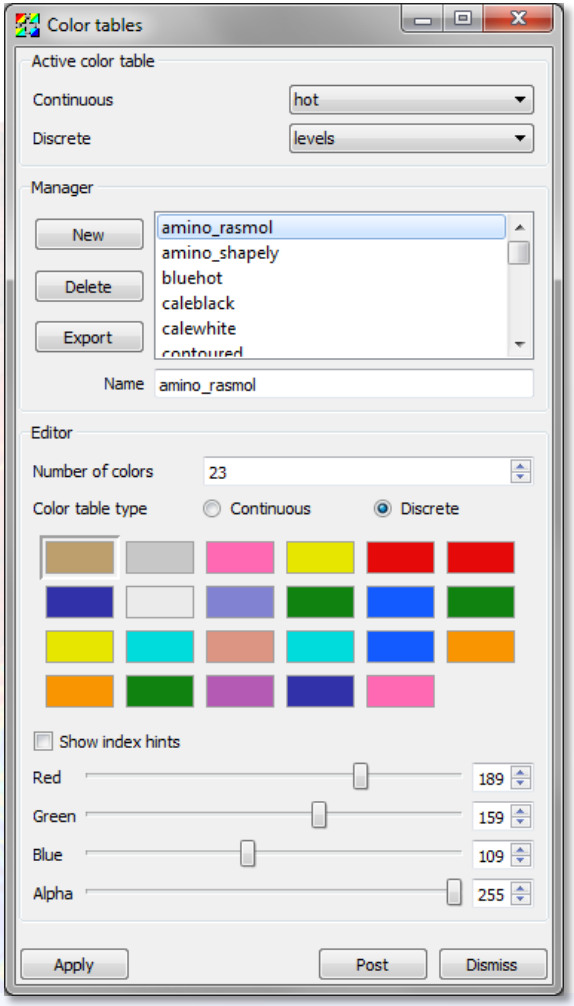
# Custom Color Table Example





# Editing a Discrete Color Table



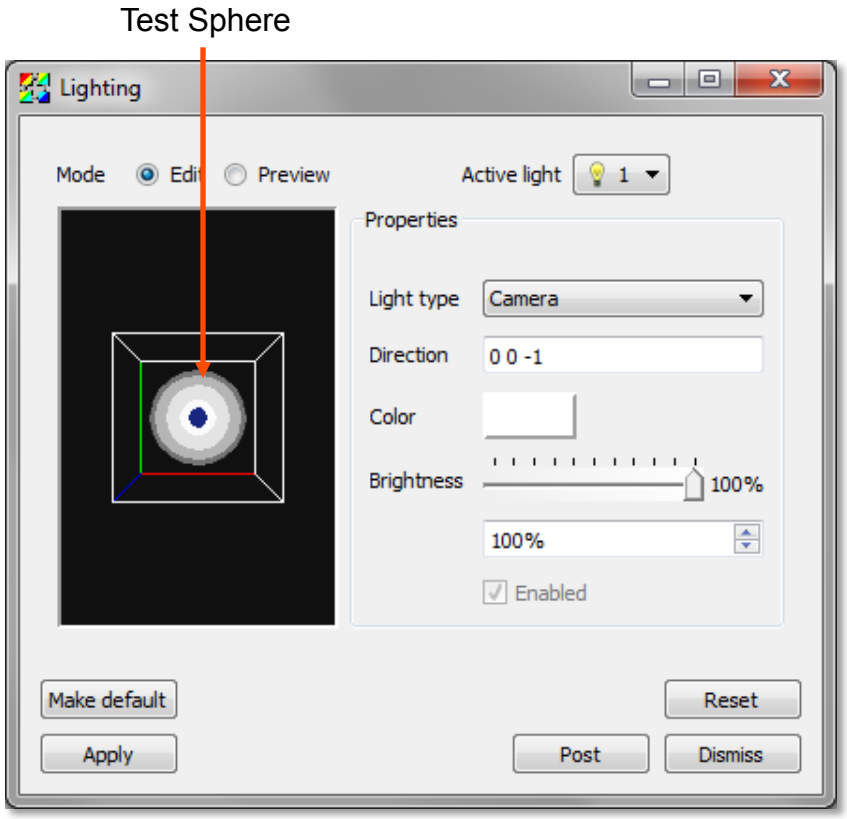

- The Editor portion of the Color table window shows a grid of colors that correspond to the colors in the discrete color table
- To edit this color table, use the Red, Green or Blue sliders with the mouse to change the color or begin by right clicking on the color to select a new color from the Popup Color Menu

# Lighting

- Lighting affects the brightness of plots
- 3D visualizations may need to have multiple light sources in order to illuminate the visualization properly
- VisIt allows up to 8 light sources to improve the look of 3D visualizations
- Each light source can be positioned and colored using VisIt's Lighting Window

# Lighting Window

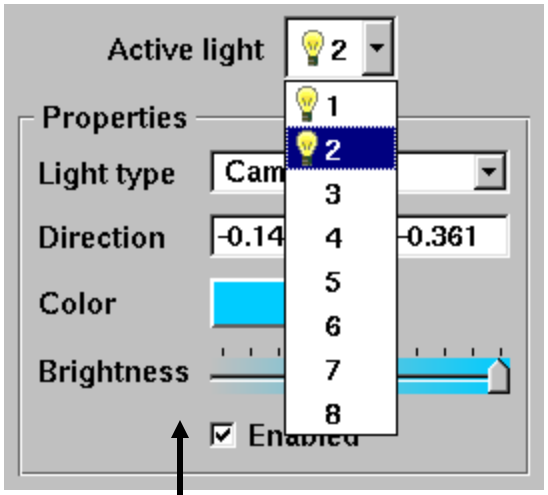
- Open the Lighting Window by selecting the Lighting option from the Main Window's Controls menu
- The Lighting Window has 2 modes of operation
  - Edit
  - Preview
- In edit mode, only the effects of the active light are shown but the light can be moved interactively
- In preview mode, light sources cannot be modified but they are all visible and illuminate the test sphere so the effect of the lighting can be observed



# Choosing the Active Light

- Only the active light can be modified so you must switch active lights each time you want to make changes to a light
- Once a new light has been selected from the pulldown, its properties are displayed in the Lighting Window's Properties panel.

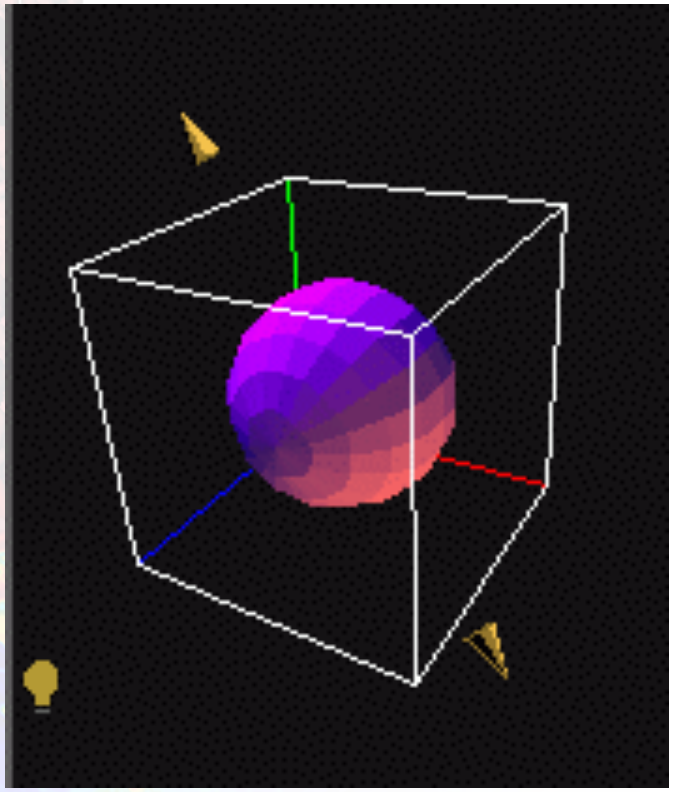
Active Light Pulldown




Properties panel

# Lights

Different kinds of lights



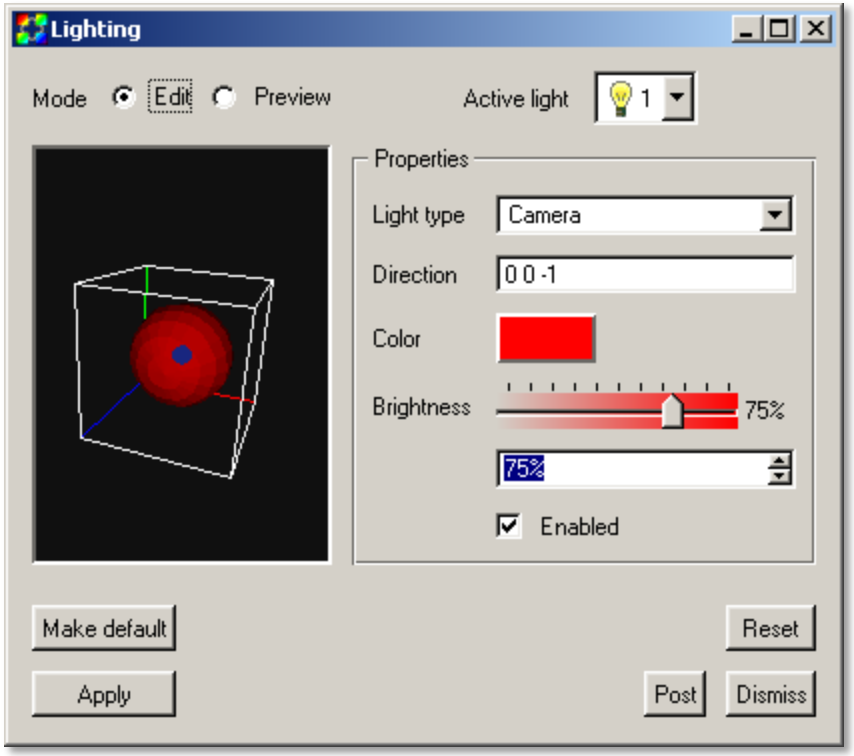
- You can modify lights only in Edit Mode
- You may turn lights on or off using the Enabled check box at the bottom of the Lighting Window's Properties panel
- VisIt supports 3 types of lights
  - Ambient
  - Camera
  - Object light

# Positioning a Light

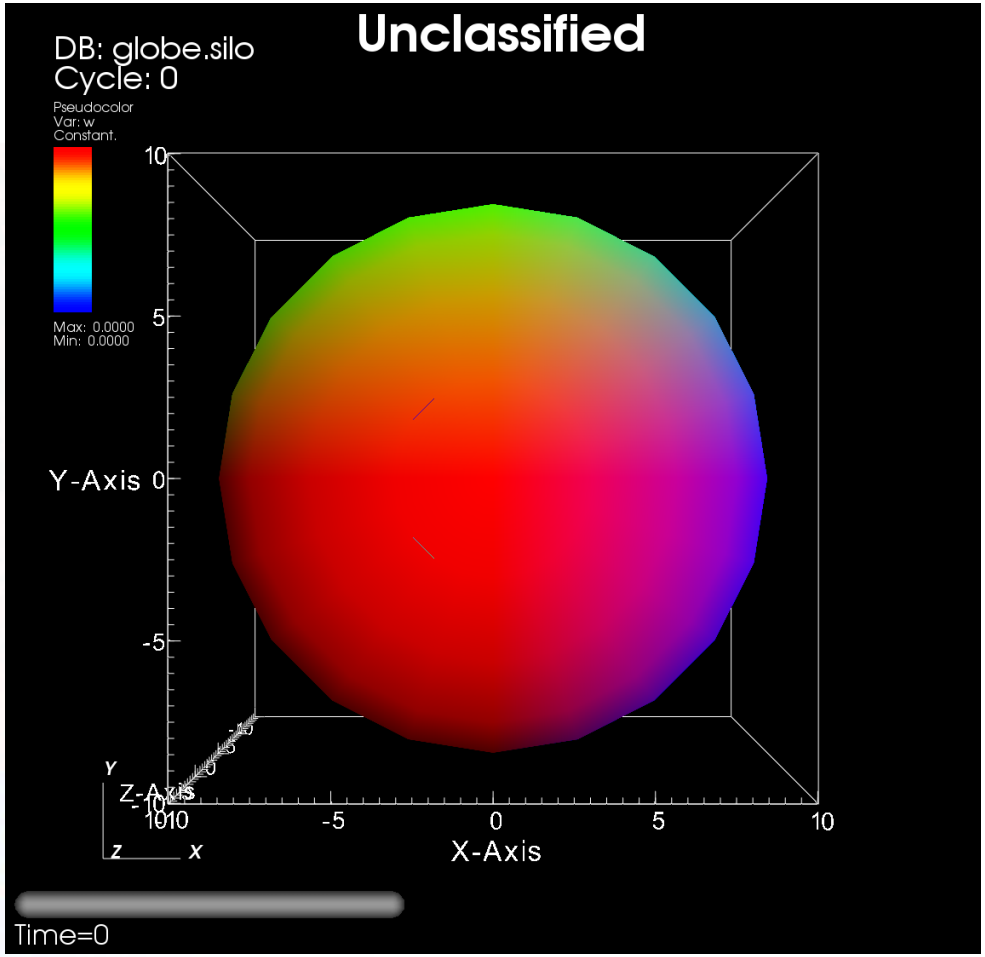
- There are two ways to position a light
  - First, drag the light to the desired location in the lighting panel. Lights move in a sphere around the test sphere.
  - The second method is to type a vector into the Direction text field.
- Note: Ambient lights have no direction.
- To change the light type for the active light, select a new light type from the Light type menu in the Properties panel

# Light Color and Brightness

- VisIt allows lights to have colors as well as brightness
- Colored lighting can produce desirable effects for presentations
- To change light color, click the Color button and select a new color from the Popup color menu
- Once color is chosen, you may also set the light's brightness. Brightness controls the intensity or dim quality of the light
- Adjust brightness with the Brightness slider in the Lighting Window



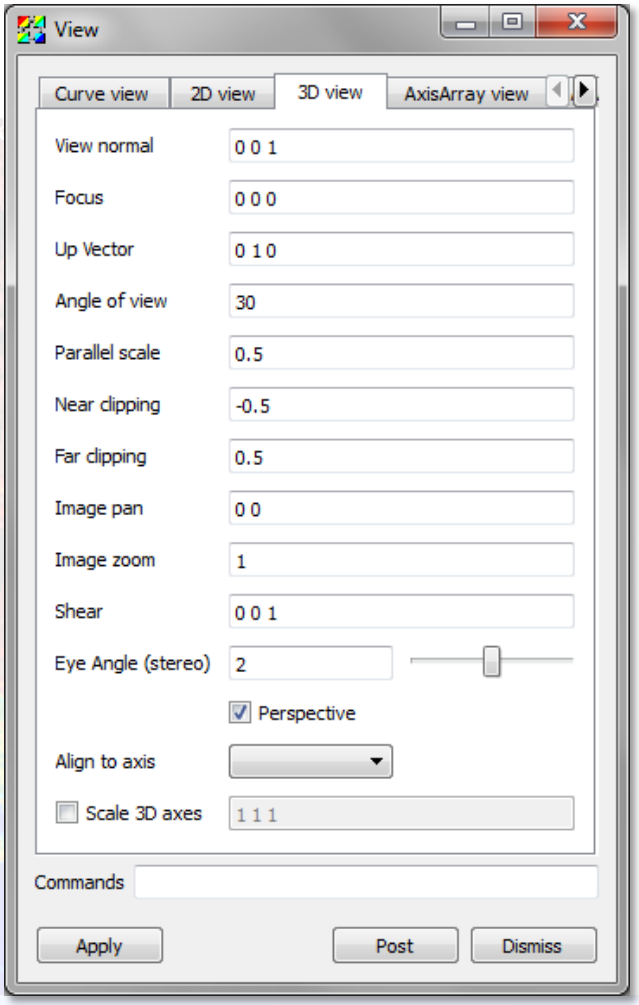
# Multiple Lights

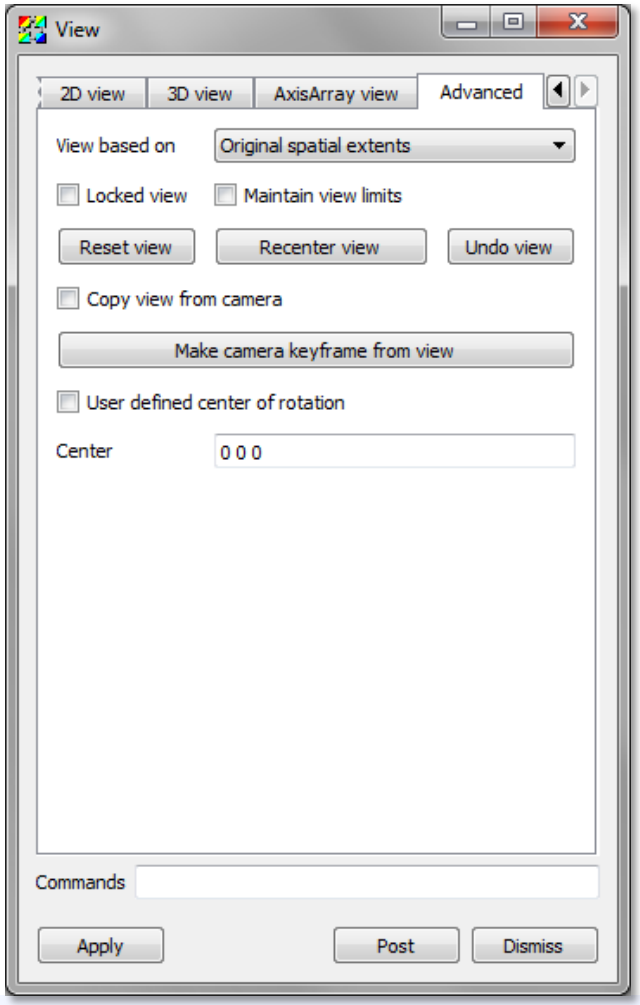


# View

- View is critical as it determines which parts of the dataset are seen
- View is also one of the most difficult properties to set
- The first and best method to edit the View is to navigate to it interactively in the vis window
- Visit provides a View Window that can be used to set the view information exactly the same every time

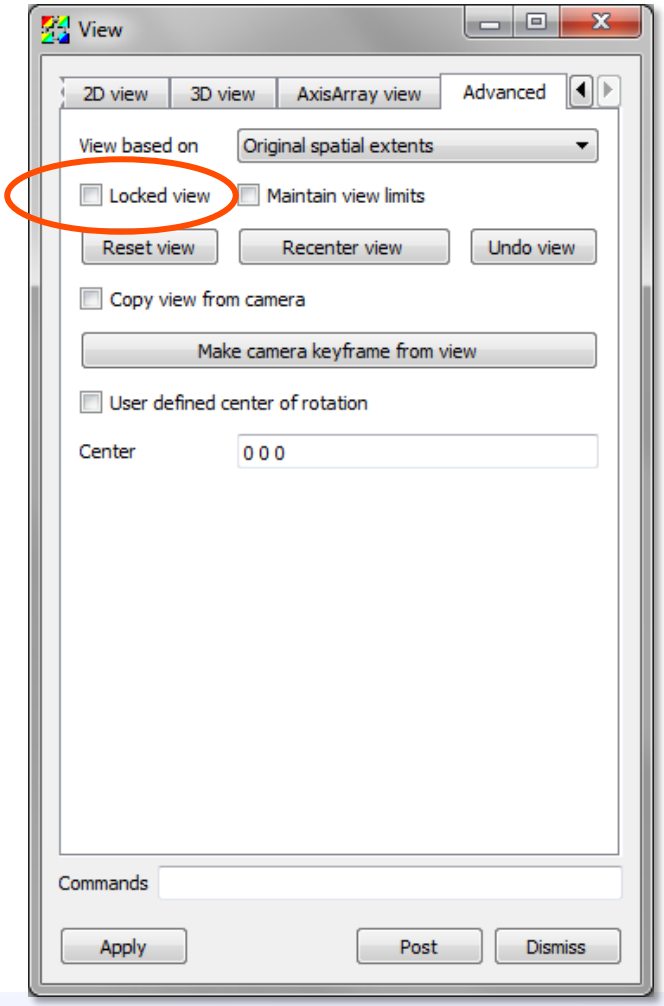
# View Window


View
Curve view
2D view
3D view
AxisArray view
View normal
0 0 1
Focus
0 0 0
Up Vector
0 1 0
Angle of view
30
Parallel scale
0.5
Near clipping
-0.5
Far clipping
0.5
Image pan
0 0
Image zoom
1
Shear
0 0 1
Eye Angle (stereo)
2
Perspective
Align to axis
Scale 3D axes
1 1 1
Commands
Apply
Post
Dismiss

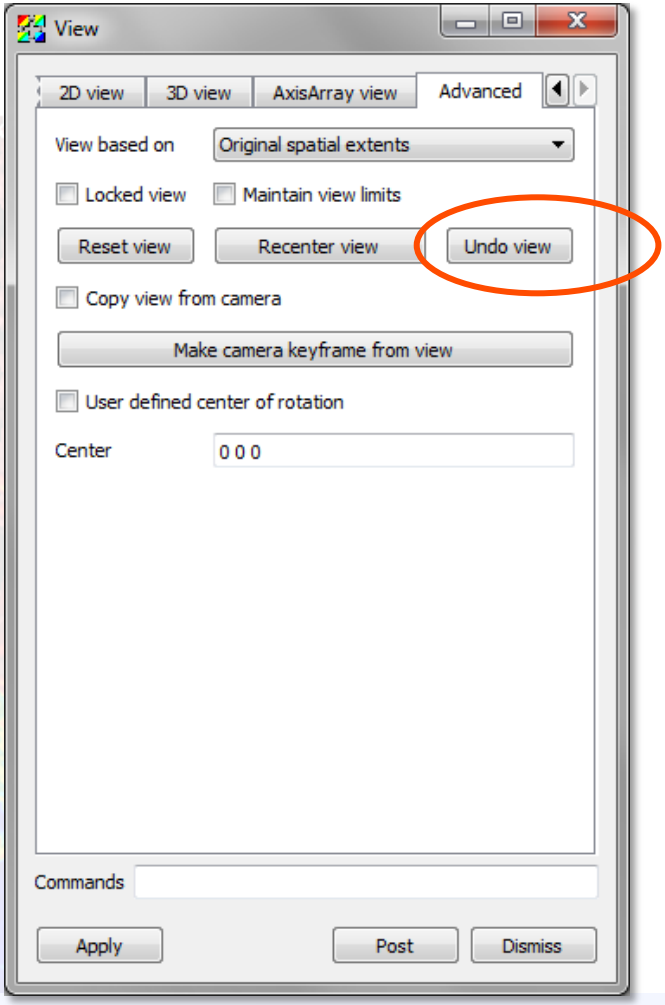

View
2D view
3D view
AxisArray view
Advanced
View based on
Original spatial extents
Locked view
Maintain view limits
Reset view
Recenter view
Undo view
Copy view from camera
Make camera keyframe from view
User defined center of rotation
Center
0 0 0
Commands
Apply
Post
Dismiss

# Locking Views

- Lock view for different vis windows so that when you change the rotate, zoom, etc. on plots in any “locked” window, all other windows with locked views get the new view
- Click the Locked view check box in the View Window’s Advanced tab or click the Toolbar button to lock views



# Undo View




- If you ever accidentally change the view when you didn't want to change it, you can click on the Undo view button
- The last 10 views are stored so you can undo up to 10 view changes

# Exercise Group 9

# Animation and Keyframing

# Lesson Goals

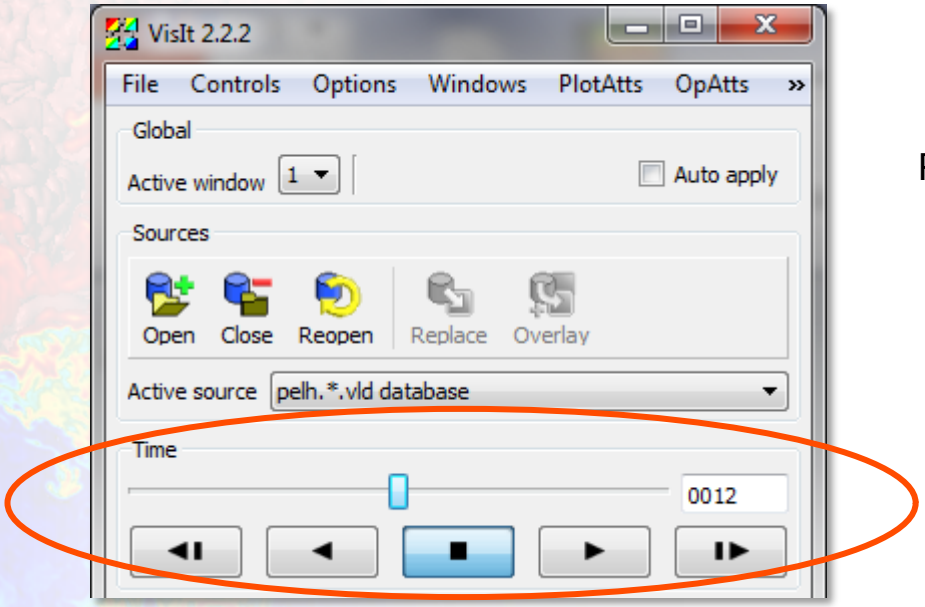
- In this lesson, you will learn about the three ways of creating animations using VisIt
  - Flipbooks
  - Keyframing
  - Scripting

# Animation

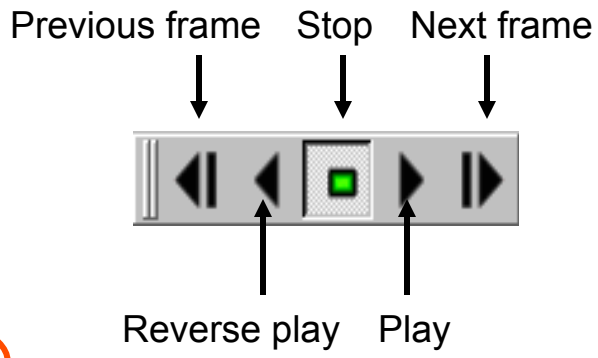
- Used mainly for looking at how scientific databases evolve over time
- Used for presentation quality movies

# Flipbook Animation

- Strictly used for static animations in which only the database timestep changes
- Allows database behavior over time to be quickly inspected without the added complexity of scripting or keyframing
- The VCR buttons allow you to control how a flipbook animation plays



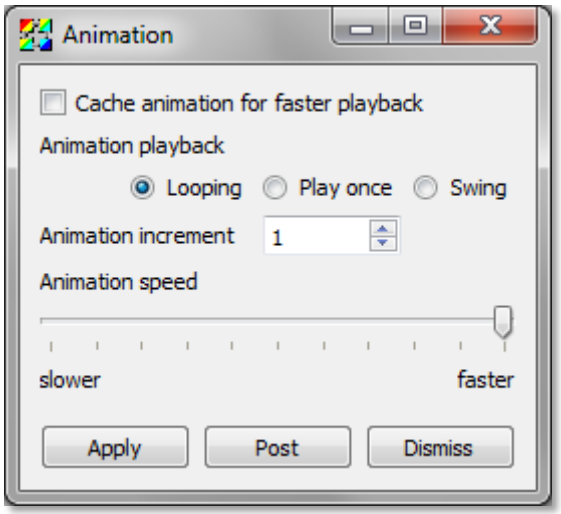

Animation toolbar



# Animation Window

- Contains controls that allow you to turn off pipeline caching and adjust the playback settings
- Playback mode
  - Looping plays animation over and over
  - Play once plays the animation once and then stops
  - Swing plays the animation to the end then reverses direction
- Playback speed determines how fast VisIt cycles through the animation frames.
- Adjust the playback speed by moving the Animation speed slider. At the "faster" setting, VisIt plays the animation as fast as the host graphics hardware allows

Animation window



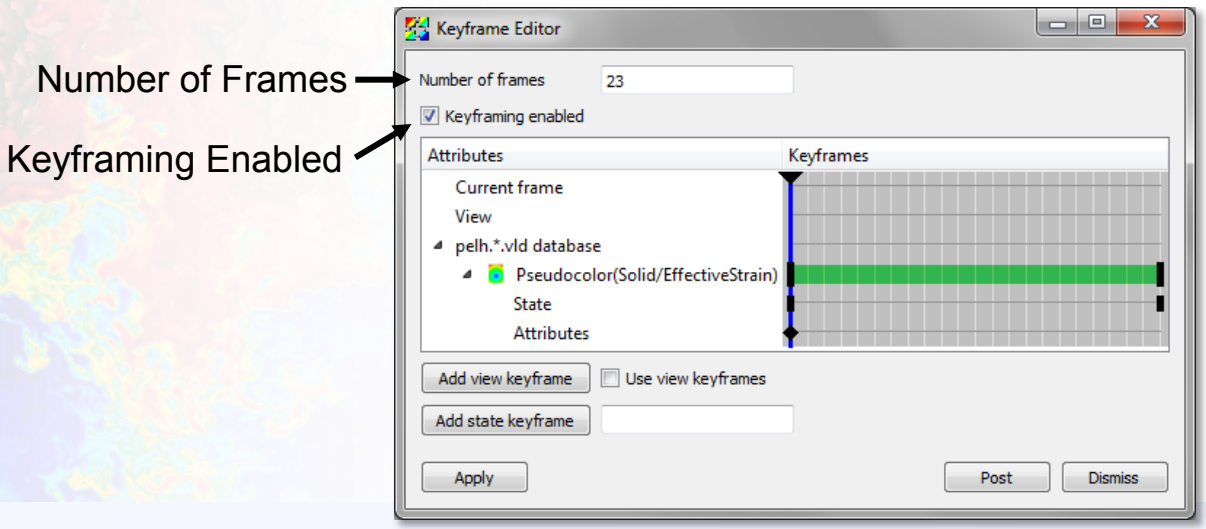
# Keyframing

- Advanced form of animation that allows attributes to change as the animation progresses
- Attributes that can be keyframed
  - Plot attributes
  - Database states
  - View
- You can make a plot fade out as the animation progresses or you can make the view slowly change

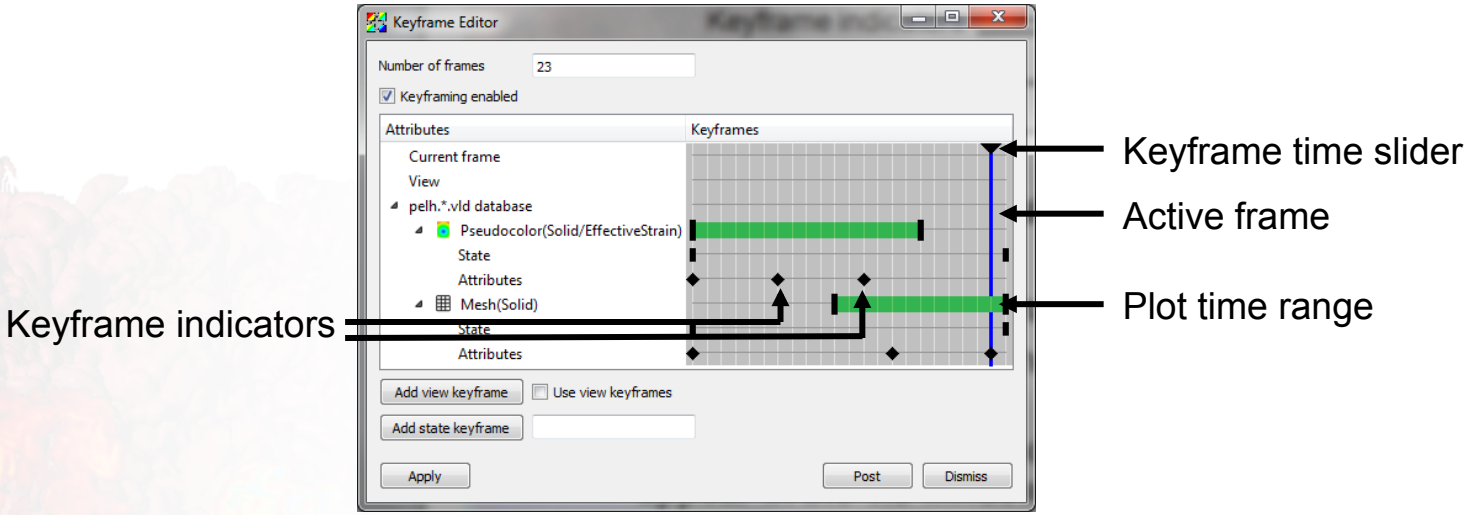
# Keyframing, Continued…

- Keyframes cannot be set if keyframing mode is not enabled
- In Keyframing mode, a keyframe is created each time you set plot attributes
- You may adjust the number of frames manually

Keyframing Window

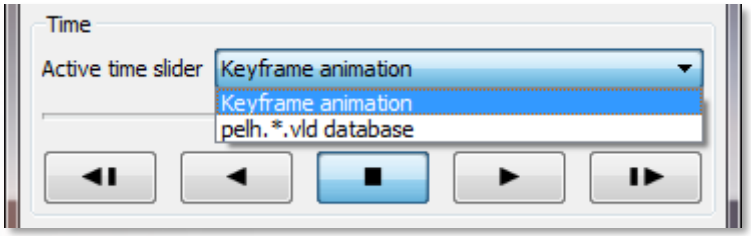


# Keyframing, Continued…




- Plot attributes are calculated for each frame using the plot keyframes
- Set the time range over which a plot exists
  - Grab the endpoints of the plot time range and move them to set the plot's time range
  - When a plot does not exist for a given animation time, it does not appear in the vis window

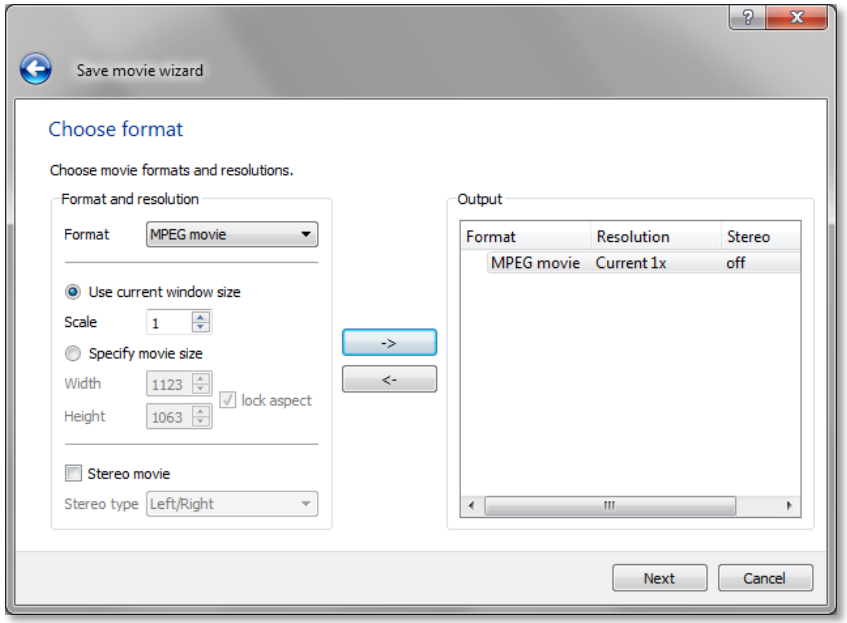
# Keyframing Time Slider




- Keyframing adds another time slider called “Keyframe animation” to the list of time sliders
- When there is more than one time slider, you can select between them using the Active time slider menu in the Main Window’s Time Controls

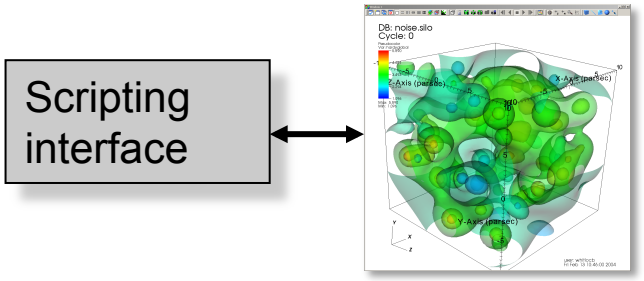
# Save Movie Wizard

- Easily make a movie of your current visualization
  - Make several formats and resolutions at the same time
  - Make stereo movies
- Generate a movie using your currently allocated processors or spawn another VisIt session for movie-making
- Use movie templates to assemble complex sequences of frames



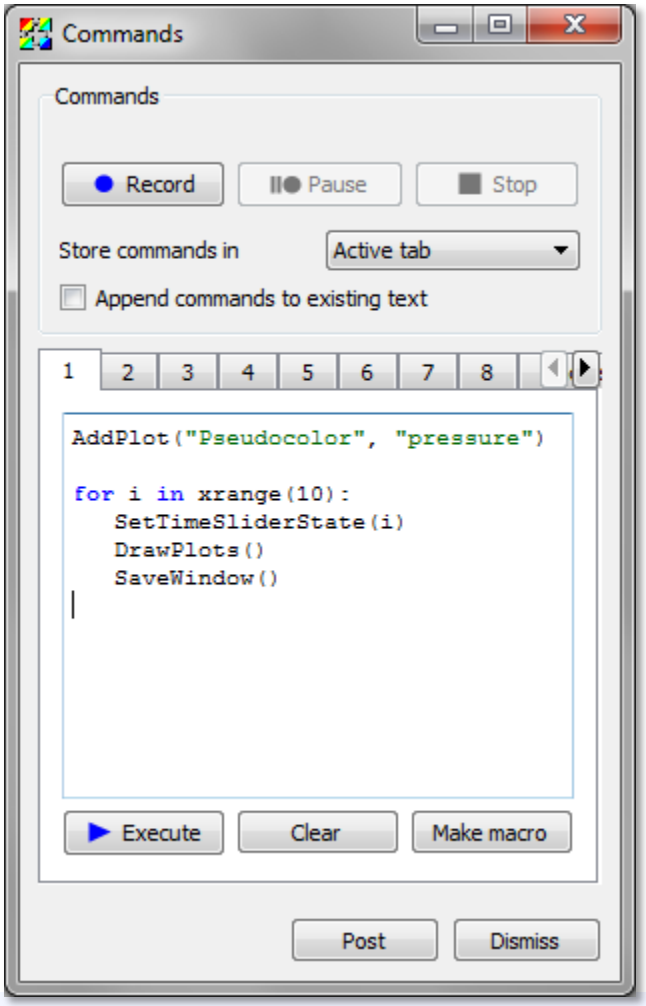
# Scripting

- For complex animations with hundreds or thousands of database timesteps, scripting is the best way to create an animation
- Scripting can be used to generate animation frames in a batch computing environment
- Scripting animations is more difficult than other methods because you must script each event by writing a Python or Java program to control VisIt's viewer



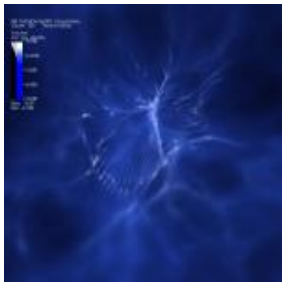
# Commands Window

- The Commands Window helps with script development and automation
- VisIt's Python interface and the GUI can both drive the viewer at the same time
- Type in Python scripts that help you automate tasks such as setting up plots
  - Scripts are saved in your settings
- Record GUI actions as Python macros that you can edit, execute, and save
  - Makes it easier to develop scripts
  - Save recorded scripting as macros that can be executed with a button click



# Exercise Group 10

# Support and Contact Information



- Contact us at visit-users@email.ornl.gov if you have questions
- Visit us on the Web at http://www.llnl.gov/visit
- User Community Wiki at http://www.visitusers.org
- User Community Forum at http://www.visitusers.org/forum/forum.pl
- Online Bug Tracker at http://visitbugs.ornl.gov